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THE FESTIVUS

A publication of the San Diego Shell Club

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Meeting date: third Thursday, 7:30 PM
Room 104, Casa Del Prado, Balboa Park

PROGRAM

Local Oceans Past and Present

Award-winning underwater photographer Mike Johnson will be the evening's speaker. He will present a program of his slides showing the marine life along this coast, both above and below the water line.

Shells of the month: California shells
Meeting date: January 19, 1994

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CLUB NEWS

Some Changes in The Festivus

With this issue **The Festivus** begins its 26th year of continuous publication. From its beginning in 1970, the publication has grown from being mimeographed, to being produced by instant print from a manual typewriter, then an electric typewriter and finally in 1990 on computer. Now, we begin 1995 with a new, more advanced computer and have made some small changes in the "look" of the publication. We hope it will meet with your approval.

The Festivus can now accept manuscripts on a variety of disks from the 5¼ floppies to the 3½ -- and, of course, continues to welcome typewritten and/or legibly handwritten submissions. Even though we use **WordPerfect** 6.0 for **Windows**, we can convert from most other word processing programs.

We continue to welcome photographs with the texts, and can have halftones made from color prints, slides or black and white images. We will continue to have occasional color plates as they benefit the "stories" they accompany.

The Club's Annual Christmas Party

It was a terrific affair! Chairman and Master of Ceremonies Bill Romer did a first rate job in making the arrangements for the party and over forty people greatly appreciated his efforts.

The spacious, warm, and friendly room with large Christmas tree was a delightful place. Members and guests, dressed for the occasion, enjoyed each others' company, the fine food, and the evening's program which included a brief installation (and outstallation) of officers and slides from different places and different times. The program ended with the traditional gift exchange and members lingered to visit with each other for awhile longer. It was one of the best parties yet.

Dues are Overdue

For those who have not yet paid their dues, this will be your last issue. To receive the February issue and be included in the Club roster (which comes out in the February issue), dues must be received by the end of January.

From the Minutes
San Diego Shell Club Meeting --November 17, 1994

The meeting was brought to order at 7:40 p.m. by President Hugh Bradner. The minutes of the previous meeting were accepted as published in **The Festivus**. Margaret Mulliner informed the members of the addition to the Club library of the much anticipated second volume of Barry Wilson's **Australian Marine Shells,** thanks to the generous donation by John Jackson.

Election of officers for 1995 was held and all were elected unanimously -- President: Kay Klaus; Vice President: Kim Hutsell; Treasurer: Margaret Mulliner; Recording Secretary: Silvana Vollero; Corresponding Secretary: Rick Negus. Installation of officers will be at the Club Christmas party.

Larry Buck introduced the speaker for the night, Bill Schneider, who gave a wonderful talk and slide presentation about fossil collecting in Baja California. He covered most of the collecting sites from San Quintín to Mulege, including the road metal quarries and several marine terraces. He also brought many reference books and three tables of fossils collected on his many trips. This was a very informative talk and there were many, many questions asked during and after the program.

A mini-auction of books followed the program. During the refreshment and social time, with cookies supplied by Hugh and Marge Bradner, there was much discussion about all the wonderful fossils brought in by the Schneiders.

Rick Negus

An Additional Video Available For Circulation from the Club Library

An additional video is available for circulation from the Club library. This program entitled, "Diving and Exploring Western Australia" was presented to the Club by Dr. Henry Chaney in October 1994. For other available videos, see **The Festivus** (1992, vol. 24(6):65).

A ZOOGEOGRAPHIC SUMMARY OF THE MARINE MOLLUSKS OF THE REVILLAGIGEDO ISLANDS (TROPICAL EASTERN PACIFIC OCEAN)

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Central Park West at 79th Street, New York, New York 10024-5192, USA

INTRODUCTION

The remote Revillagigedo Islands [Islas Revillagigedo] are a possession of Mexico. This Archipelago consists of three major islands (Socorro [Isla Socorro], San Benedicto [Isla San Benedicto], and Clarion [Isla Clarión] and one barren, rocky islet [Isla Roca Partida]) formed by volcanic activity in the Clarion Fracture Zone between 18°20' and 19°20'N and 110°45' and 114°50'W. The Revillagigedo Archipelago stands in isolation, some 400 km southwest of Cabo San Lucas, Baja California Sur, Mexico, and about 650 km west of the Mexican mainland (Figure 1). These oceanic islands are positioned ca. 1,000 km north of Clipperton Island and more than 5,000 km east of the Hawaiian Islands (Ferreira, 1983:307). Compared to Clipperton Island, a "near-atoll", they are "high-islands" (cf. Stoddard, 1992), with Socorro having the most elevated of the volcanic peaks of the three islands and attaining 1,130 m [3,707 ft] above sea level.

Socorro Island (18°45'N, 110°58'W) is the largest in the Archipelago with a land area of about 159 square kilometers topped with a rugged central peak. This nearly circular island lies some 43 km SSW of San Benedicto Island and 396 km southwest of Cabo San Lucas. Although sand beaches are few in number and limited in size, rocky shores abound with precipitous cliffs. Prominent coral reefs and localized coral patches, together with a small lagoon, occur along the western coast (Hanna, 1926; Lewis and Ebeling, 1974).

Clarion Island (18°22'N, 114°45'W), the westernmost of the Archipelago, is situated about 335 km WSW of Socorro Island. The Island is some 8 km long and no more than 3.25 km wide and is characterized by three prominent volcanic peaks, all of which exceed 284 m [933 ft] in elevation. The shore is rocky with precipitous sea cliffs and the few exposed sandy beaches are largely limited to Sulphur Bay. A well-developed coral reef is present on the south side of the Island, including reefs in Sulphur Bay (Hanna, 1926; Lewis and Ebeling, 1974).

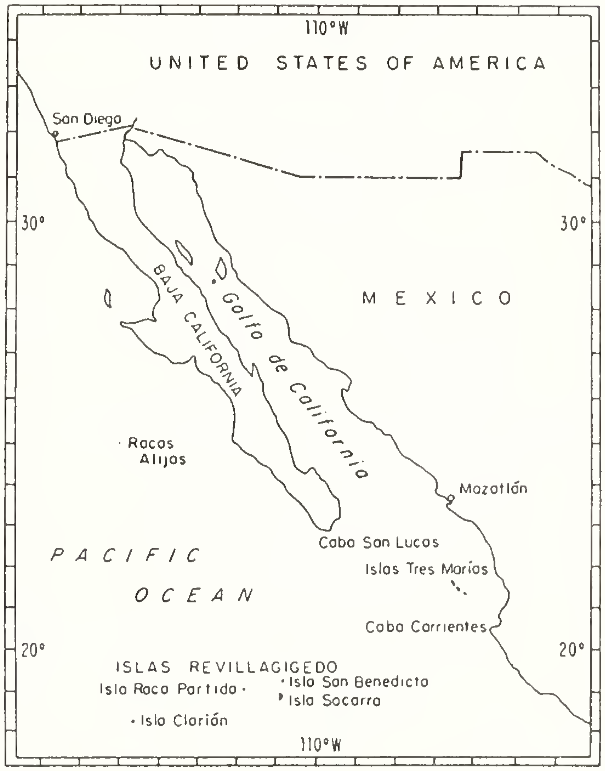

Figure 1. A chart showing the location of the Revillagigedo Islands (after Richards, 1966:364).

The Revillagigedo Islands are primarily influenced by the western flow of the temperate California Current as it picks up warmer water and swings off the Mexican coast to become the South Equatorial Current (Zinsmeister & Emerson, 1979; Bernard *et al.*, 1991:18) and by extensions of the North Equatorial Counter Current from the southeast (Finet, 1991).

The available collecting records compiled from the literature and/or from collections for the shelled marine mollusks (Table 1) are largely confined to Socorro Island and Clarion Island, and the discussion section that follows is restricted to these insular populations.

The following abbreviations are used to designate institutional collections and personnel:

AMNH - American Museum of Natural History, New York.
ANSP - Academy of Natural Sciences of Philadelphia.
CAS - California Academy of Sciences, San Francisco.
LACM - Los Angeles County Museum of Natural History, California.
MPB - Museum of Paleontology, University of California, Berkeley.
SBMNH - Santa Barbara Museum of Natural History, California.
SDNHM - San Diego Natural History Museum, California.
USNM - National Museum of Natural History, (U.S. National Museum Collection), Smithsonian Institution, Washington, D.C.

ZOOGEOGRAPHIC CONSIDERATIONS

The Revillagigedo Islands have long been known for their unique terrestrial plants and animals (see Baptista, 1993; Jehl & Parkes, 1982). On Socorro Island, ten endemic species or subspecies of land birds and one native seabird have been recognized, together with several endemic bee species, an endemic scorpion, and an endemic lizard. Some of the land birds may now be extinct, or are severely threatened owing to habitat destruction by feral sheep and by predation resulting from introduced cats and pigs. The endemic elf owl has not been observed recently and may be extinct. The Socorro Island dove is locally extinct, but breeding pairs are being successfully maintained in foreign aviaries, and Dr. Baptista (1993:43) holds promise that "...one day [this dove] will be reintroduced to the island."

The composition of the marine invertebrate fauna of the Revillagigedo Archipelago remains poorly documented. Most of the infrequent biological surveys, dating from Grayson's list (1872) of the birds he collected at Socorro Island in 1867, have concentrated on the terrestrial biota and the marine fish fauna (Ferreira, 1983). An annotated bibliography pertaining to the discovery and exploration of the Islands, including marine biological surveys, was compiled by Richards and Brattstrom (1959:329-335), for the period 1533 to 1957.

Stearns (1894:143) had lamented that "...we know but little or nothing [about Socorro Island]"; but he noted, "The few marine shells that have been brought from there are, as would be supposed, familiar gulf [of California] forms". Dall (*in* Dall & Ochsner, 1928:90), on the other hand, observed, based on the sparse collections available to him, "...the marine invertebrate fauna of Clarion Island ... so far as yet explored, is of a strictly Indo-Pacific type and presents a strong contrast to the fauna of the Galapagos." The findings of Strong and Hanna (1930) served to refute Dall's (1916:701; Dall & Ochsner, 1928) conclusions, as they recognized only two Indo-Pacific species among the 61 Revillagigedo molluscan species, of the mostly Panamic faunal elements resulting from the 1925 Expedition of the California Academy of Sciences (Hanna, 1926). Significant collections of Revillagigedo marine mollusks now in the LACM were obtained by the Allan Hancock Pacific Expeditions of 1934 (January 2-6, June 8-11) and 1939 (March 16-18), mostly by dredging in 15-115 m (Fraser, 1943). Many of these records are compiled herein (Table 1) based on the LACM computer catalog data base, through the courtesy of J. H. McLean and L. T. Groves. Bernard *et al.*, (1991:31) list 29 species of Revillagigedo bivalves, based largely on the Allan Hancock Foundation collections (LACM), but they did not cite specific occurrences for the Clarion or Socorro populations. The Presidential Cruise of 1938 obtained 11 species (6 gastropods and 5 bivalves) from Socorro Island (Bartsch & Rehder, 1939; USNM). The chiton fauna, totaling eight species, was reviewed and enumerated by Ferreira (1983), based mainly on collections in the CAS and LACM.

The present compilation confirms that the shallow-water molluscan fauna of Clarion and Socorro Islands are dominated by the Panamic faunal element. Of the 175 taxa of shelled mollusks (42 bivalves; 125 gastropods; 8 polyplacophorans) reported herein, 129 species (74%) have Panamic affinities (Table 1). The second largest faunal element is Californian with 14 species (8%), followed by 7 Indo-Pacific species (4%), 6 Endemics (3%), 9 Cosmopolitan-Circumtropical (5%), 5 Aleutian-Californian (3%), 3 Californian-Panamic (2%), and 2 Aleutian-Panamic (1%). With the exception of 1 Indo-Pacific species, 6 endemic species and 2 insular endemic species, all the remaining species are known from the west American continental borderland. Less than half of the 174 species are recorded from both Clarion Island and Socorro Island. This may reflect, in large part, an artifact of field collecting and data compiling bias.

None of the 42 bivalve species are endemic nor have Indo-Pacific faunal affinities. Present are minor elements representing 1 cosmopolitan warm-water species, 2 Aleutian-Californian species, and 2 Californian-Panamic species, whereas the remaining 37 bivalve species (88%) are Panamic faunal elements.

Of the 125 species of gastropods, 88 species, the vast majority (70%), are also Panamic species. The second largest gastropod faunal element is the Californian with 10 species (8%), followed by Circumtropical-Cosmopolitan (8 species; 6%), Indo-Pacific (6 species; 5%), Endemic (5 species, 4%), Aleutian-Californian (5 species; 4%), Californian-Panamic (1 species; 1%) and Aleutian-Panamic (2 species; 2%). Of the 8 species of chitons, there are 4 Panamic, 1 Californian, 1 Californian-Panamic, 1 Indo-Pacific, and 1 Endemic. Three shelled opisthobranchs and 1 pulmonate are included in the gastropod compilation. The opisthobranch gastropod fauna, however, is being studied and enumerated by Dr. Terrence Gosliner (*in litt.* July 8, 1992). The micromollusks remain largely unknown. The scaphopods and cephalopods were not compiled.

The provincial faunal composition of the Revillagigedo Islands is in sharp contrast to that of Clipperton Island, where the majority of the 92 reported marine molluscan species (gastropods and bivalves) are nearly equally divided between the Indo-Pacific (43%) and Panamic (41%) faunal elements (Emerson, 1994). Compared to the faunas of the Galapagos Islands and Cocos Island, the Revillagigedos share a large component of Panamic provincial elements. Finet (1991:257) recognized more than half of the 600+ Galapagan marine molluscan species (including scaphopods and cephalopods) as Panamic (52%), with a large segment of endemics (18%), but only a small element of Indo-Pacific species (3%), and the remainder with Californian-Panamic, Panamic-Peruvian, trans-American, and Circumtropical faunal affinities. Montoya (1988) recorded for Cocos Island, based on 429 marine species (including scaphopods and cephalopods), a dominant Panamic element (88%) and a minor Indo-Pacific element (7.5%). These complilations are in the process of being revised as the taxonomy is reviewed, additional species are discovered, and new species are recognized and described from these insular populations.

The species records that follow (Table 1) provide a database for future studies of the biodiversity of the shallow-water marine mollusks of the Revillagigedo Islands.

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TABLE 1.

Shallow Water Marine Mollusks of the Revillagigedo Islands (Islas de Revillagigedo)
[Classification generally follows Keen (1971); Skoglund (1989, 1991a, 1991b, 1992)]

Keen No.	Species	Faunal	Source of Record	Clarion Id.	Socorro Id.	Other Tropical Eastern Pacific Oceanic Island Occurrences	Known from West-American Mainland
			1 = Clarion Id. 2 = Socorro Id. 3 = San Benedicto Id. 4 = "Revillagigedo Ids."			[Bivalvia after Bernard, 1983; Bernard, *et al.*, 1991 unless otherwise indicated. Gastropoda after Keen, 1971, unless otherwise indicated.]	[Bivalvia after Keen, 1971; Bernard, 1983. Gastropoda after Keen, 1971; Skoglund, 1992. Polyplacophora after Ferreira, 1983; Kaas & Van Belle, 1987.]
	BIVALVIA (N = 42 species)						
	ARCIDAE						
90	*Anadara multicostata* (Sowerby)	Panamic	^{4}Bernard *et al.*, 1991	?	?	Galapagos Ids.; Cocos Ids.	x
66	*Arca mutabilis* (Sowerby)	Panamic	^{2}CAS	-	x	Clipperton Id.; Galapagos Ids. (SBNHM); Cocos Id.	x
67	*Arca pacifica* (Sowerby)	Panamic	^{4}Bernard *et al.*, 1991	?	?	Galapagos Ids.; Cocos Id.	x
99	*Arcopsis solida* (Sowerby)	Panamic	^{1}Strong & Hanna, 1930; ^{4}Bernard *et al.*, 1991	x	?	Galapagos Ids.; Cocos Id.	x
70	*Barbatia bailyi* (Bartsch)	Panamic	^{4}Bernard *et al.*, 1991	?	?	Galapagos Ids. (Finet, 1991)	x
	GLYCYMERIDIDAE						
114	*Glycymeris inaequalis* (Sowerby)	Panamic	^{4}Bernard *et al.*, 1991	?	?	Galapagos Ids.; Cocos Id.	x
	MYTILIDAE						
143	*Lithophaga aristata* (Dillwyn)	Panamic	^{4}Bernard *et al.*, 1991; ^{2}Soot-Ryen, 1955	?	x	Cocos Id. (Montoya, 1983); Galapagos Ids.	x
145	*Lithophaga calyculata* (Carpenter)	Panamic	^{1}Strong & Hanna, 1930; ^{1,2}Soot-Ryen, 1955; ^{4}Bernard *et al.*, 1991	x	x	Clipperton Id.; Cocos Ids.; Galapagos Ids.	x

149	*Modiolus capax* (Conrad)	Californian-Panamic	^{4}Bernard *et al.*,1991	?	?	Galapagos Ids.	x
---	*Mytilus californianus* Conrad	Aleutian-Californian	^{4}Bernard *et al.*, 1991; ^{2}Soot-Ryen, 1955; ^{2}Skoglund, 1991b	?	x	---	x
129	*Septifer zeteki* Hertlein & Strong	Panamic	^{4}Bernard *et al.*, 1991; ^{2}Soot-Ryen, 1955	?	x	Galapagos Ids.; Cocos Id.	
	ISOGNOMONIDAE						
163	*Isognomon janus* Carpenter	Panamic	^{1}Bartsch & Rehder, 1939; ^{2}AMNH	x	x	Clipperton Id. (Hertlein & Allison, 1966); Galapagos Ids.; Cocos Id. (AMNH)	x
164	*Isognomon recognitus* (Mabille) (not *I. gaudichaudi* (d' Orbigny) *sensu* Bernard, 1983, *teste* E. V. Coan)	Panamic	^{1}Strong & Hanna, 1930; ^{2}AMNH	x	x	Clipperton Id. (Hertlein & Allison, 1966); Cocos Id. (Montoya, 1983); Galapagos Ids. (Finet, 1991)	x
	MALLEIDAE						
165	*Malleus regulus* (Forskål) (= *Avicula candeana* d'Orbigny *in* Sagra)(see Bernard, 1983:22, for synonyms)	Cosmopolitan in warm water	^{1}Strong & Hanna, 1930	x	-	Galapagos Ids.; Cocos Id. (Shasky, 1986)	x
	PECTINIDAE						
182	*Argopecten circularis* (Sowerby)	Panamic	^{4}Bernard *et al.*, 1991	?	?	Galapagos Ids.; Cocos Id.	x
183	*Spathochlamys vestalis* (Reeve) (=*Chlamys lowei* (Hertlein), *fide* Waller, 1993:234)	Panamic	^{1}Grau, 1959; ^{1}USNM; ^{4}Bernard *et al.*, 1991	x	-	Galapagos Ids.	x
190	*Cyclopecten pernomus* (Hertlein)	Panamic	^{1}LACM; ^{1}Grau, 1959; ^{2}USNM; ^{4}Bernard *et al.*, 1991	x	x	Galapagos Ids.	x
177	*Flabellipecten sericeus* (Hinds)	Panamic	^{1}Grau, 1959; ^{2}USNM; ^{4}Bernard *et al.*, 1991	x	x	Cocos Id. (Montoya, 1983); Galapagos Ids.	x
202	*Nodipecten subnodosus* (Sowerby)	Panamic	^{1}Grau, 1959; ^{1}Smith, 1991; ^{1,2}USNM; ^{4}Bernard *et al.*, 1991	x	x	Cocos Id. (Montoya, 1983; Smith, 1991); Galapagos Ids. (Finet, 1991)	x
180	*Oppenheimopecten perulus* (Olsson)	Panamic	^{2}USNM	-	x	Cocos Id.	x
	SPONDYLIDAE						
210	*Spondylus calcifer* Carpenter	Panamic	^{4}Bernard *et al.*, 1991	?	?	Cocos Id. (Bakus, 1975)	x
	ANOMIIDAE						
223	*Anomia peruviana* d'Orbigny	Californian-Panamic	^{4}Bernard *et al.*, 1991	?	?	Clipperton Id.; Galapagos Ids.; Cocos Id.	x
	CARDITIDAE						
241	*Cardita laticostata* (Sowerby)	Panamic	^{4}Bernard *et al.*, 1991	?	?	Galapagos Ids.; Cocos Id.	x

	LUCINIDAE						
279	*Codakia distinguenda* (Tryon)	Panamic	[1]Strong & Hanna, 1930; [4]Bernard *et al.*, 1991	x	-	Clipperton Id.; Galapagos Ids. (Finet, 1991); Cocos Id.	x
281	*Ctena clarionensis* Hertlein & Strong	Panamic	[1]Hertlein & Strong, 1946	x	-	Cocos Id.	x
284	*Ctena mexicana* (Dall)	Panamic	[4]Bernard *et al.*, 1991	?	?	Galapagos Ids.	x
268	*Lucina lampra* (Dall)	Panamic	[4]Bernard *et al.*, 1991	?	?	---	x
	UNGULINIDAE						
292	*Diplodonta subquadrata* (Carpenter)	Panamic	[1]Strong & Hanna, 1930; [4]Bernard *et al.*, 1991	x	-	Galapagos Ids.; Cocos Id.	x
	CHAMIDAE						
354	*Pseudochama clarionensis* Willett	Panamic	[1]Willett, 1938; [1]LACM	x	-	Galapagos Ids. (Bernard, 1976); Cocos Id.	x
	CARDIIDAE						
361	*Acrosterigma pristipleura* (Dall)	Panamic	[2]Bartsch & Rehder, 1939; [1,2]LACM	x	x	---	x
377	*Laevicardium clarionense* (Hertlein & Strong)	Panamic	[1]Hertlein & Strong, 1947	x	-	---	x
379	*Laevicardium elenense* (Sowerby)	Panamic	[1]Soot-Ryen, 1932	x	-	Galapagos Ids.	x
	VENERIDAE						
445	*Chione undatella* (Sowerby)	Californian-Panamic	[4]Bernard *et al.*, 1991	?	?	Galapagos Ids.	x
456	*Chionopsis purpurissata* (Dall)	Panamic	[1]LACM	x	-	---	x
426	*Dosinia dunkeri* (Philippi)	Panamic	[4]Bernard *et al.*, 1991	?	?	Galapagos Ids.	x
386	*Tivela delessertii* (Sowerby)	Panamic	[2]Bartsch & Rehder, 1939	-	x	---	x
394	*Transennella modesta* (Sowerby)	Panamic	[4]Bernard *et al.*, 1991	?	?	Galapagos Ids.	x
	TELLINIDAE						
537	*Tellina ochracea* Carpenter	Panamic	[4]Bernard *et al.*, 1991	?	?	Galapagos Ids.; Cocos Id.	x
	SEMELIDAE						
628	*Semele craneana* Hertlein & Strong	Panamic	[1]Keen, 1971; [4]Bernard *et al.*, 1991; [1]Coan, 1988	x	?	---	x
	GASTROCHAENIDAE						
694	*Gastrochaena ovata* (Sowerby) (see Bernard, 1983, for synonyms)	Panamic (Trans-American)	[1]Strong & Hanna, 1930; [4]Bernard *et al.*, 1991	x	?	Clipperton Id.; Galapagos Ids. (Bernard *et al.*, 1991)	x
	VERTICORDIIDAE						
789	*Verticordia ornata* (d'Orbigny)	Panamic (Trans-American)	[2]LACM	-	x	Galapagos Ids. (Bernard *et al.*, 1991)	x
	PHOLADIDAE						

---	*Penitella penita* (Conrad)	Aleutian-Californian	^{4}Bernard *et al.*, 1991	?	?	---	x
	GASTROPODA (N = 125 species)						
	LOTTIIDAE						
48	*Lottia discors* (Philippi)	Panamic	^{1,2}Strong & Hanna, 1930; ^{2}AMNH; ^{1}ANSP; ^{1,2}LACM	x	x	---	x
60	*Lottia mesoleuca* (Menke)	Panamic	^{2}Strong & Hanna, 1930; ^{2}AMNH; ^{2}LACM	-	x	?Galapagos Ids. (Finet, 1985); Cocos Id. (Bakus, 1975)	x
49	*Lottia mitella* (Menke)	Panamic	^{2}LACM	-	x	Galapagos Ids. (Finet, 1991)	x
50	*Lottia pediculus* (Philippi)	Panamic	^{2}LACM	-	x	---	x
	FISSURELLIDAE						
18	*Diodora inaequalis* (Sowerby)	Panamic	^{1,2}Strong & Hanna, 1930; ^{1}ANSP; ^{1,2}LACM	x	x	Galapagos Ids.	x
19	*Diodora panamensis* (Sowerby)	Panamic	^{1}Strong & Hanna, 1930	x	-	---	x
21	*Diodora punctifissa* McLean	Panamic (Insular endemic)	^{2}LACM	-	x	Galapagos Ids. (McLean, 1970a)	-
23	*Diodora saturnalis* (Carpenter)	Panamic	^{1,2}LACM	x	x	Galapagos Ids.	x
39	*Fissurella obscura* Sowerby	Panamic	^{2}Strong & Hanna, 1930	-	x	Galapagos Ids.	?
--	*Fissurella microtrema* Sowerby	Panamic	^{1}ANSP; ^{2}LACM	x	x	Galapagos Ids. (Finet, 1991)	x
40	*Fissurella rubropicta* Pilsbry	Panamic	^{2}LACM	-	x	---	x
--	*Fissurella volcano* Reeve	Californian	^{1}Strong & Hanna, 1930	x	x	---	x
43	*Leurolepas roseola* McLean	Panamic	^{1,2}McLean, 1970a; ^{2}LACM	x	x	---	x
	TURBINIDAE						
132	*Arene socorroensis* (Strong)	Panamic	^{2}Strong, 1934; ^{2}LACM	-	x	---	x
156	*Astraea olivacea* (Wood)	Panamic	^{2}LACM	-	x	---	x
141	*Homalopoma clippertonensis* (Hertlein & Emerson)	Panamic	^{3}Keen, 1971	-	-	Clipperton Id.	x
142	*Homalopoma grippi* (Dall) (in 75 to 180 m, Keen, 1971)	Californian	^{4}Keen, 1971; ^{1}LACM	x	?	---	x
138	*Macrarene lepidotera* McLean	Endemic	^{1,2,3}McLean, 1970c	x	x	---	-
145	*Turbo funiculosus* Kiener	Panamic	^{4}Keen, 1971; ^{2}AMNH; ^{1,2}LACM; ^{2}SBMNH	x	x	---	x
149	*Turbo squamiger* Reeve	Panamic	^{1,2}LACM	x	x	?Galapagos Ids. (Finet, 1985)	x
161	*Eulithidium phasianellum* (Philippi)	Panamic	^{1}Keen, 1971	x	-	---	x
162	*Eulithidium substriatum* (Carpenter)	Californian	^{1,2}LACM	x	x	---	x
	TROCHIDAE						
83	*Calliostoma keenae* McLean	Californian	^{1}McLean, 1970b; ^{1}LACM	x	-	---	x

71	*Solariella peramabilis* Carpenter	Aleutian-Panamic	^{1}LACM	x	-	---	x
73	*Solariella triplostephanus* Dall	Panamic	^{2}LACM	-	x	---	x
109	*Tegula rubroflammulata* Koch	Panamic	^{2}LACM	-	x	---	x
	NERITIDAE						
166	*Nerita funiculata* Menke	Panamic	^{2}Strong & Hanna, 1930; ^{2}AMNH; ^{1}LACM	x	x	Galapagos Ids.	x
165	*Nerita scabricosta* Lamarck	Panamic	^{2}Strong & Hanna, 1930; ^{1}LACM	x	x	Galapagos Ids. (Hertlein & Strong, 1955); Cocos Id. (Montoya, 1983)	x
	LITTORINIDAE						
186	*Littorina pintado* (Wood) (=*L. pullata* Carpenter)	Indo-Pacific	^{2}AMNH; ^{2}CAS; ^{2}USNM; ^{1,2}LACM	x	x	Clipperton Id. (Emerson, 1991)	x
---	*Littorina keenae* Rosewater (=*L. planaxis* Philippi)	Californian	^{2}Keen, 1971; ^{2}USNM	-	x	Cocos Id. (Montoya, 1983)	x
---	*Littorina scutulata* Gould	Californian	^{1,2}Strong & Hanna, 1930	x	x	---	x
181	*Nodilittorina aspera* (Philippi)	Panamic	^{2}LACM	-	x	Galapagos Ids. (Finet, 1991); Cocos Id. (Montoya, 1983)	x
183	*Nodilittorina modesta* (Philippi) (=*L. conspersa* (Philippi))	Panamic	^{2}Strong & Hanna, 1930; ^{1,2}LACM; ^{2}USNM	x	x	Galapagos Ids. (Finet, 1991); Cocos Id. (Bakus, 1975)	x
	LACUNIDAE						
---	*Lacuna unifasciata* Carpenter	Californian	^{1}Strong & Hanna, 1930	x	-	---	x
	TURRITELLIDAE						
437	*Turritella clarionensis* Hertlein & Strong	Panamic	^{1}Hertlein & Strong, 1951; ^{1,2}LACM	x	x	---	x
444	*Turritella radula* Kiener	Panamic	^{2}LACM	-	x	---	x
445	*Turritella rubescens* Reeve	Panamic	^{2}LACM	-	x	---	x
	RISSOIDAE						
271	*Rissoina stricta* Menke	Panamic	^{2}Strong & Hanna, 1930	-	x	Galapagos Ids. (Finet, 1991)	x
	BARLEEIDAE						
194	*Lirobarleeia clarionensis* (Bartsch)	Panamic	^{1}Keen, 1971	x	-	---	x
	TRUNCATELLIDAE						
284	*Truncatella californica* Pfeiffer (=*T. stimpsoni* Stearns)	Californian	^{1}Strong & Hanna, 1930	x	-	---	x
	MODULIDAE						
491	*Modulus cerodes* (A. Adams)	Panamic	^{2}Strong & Hanna, 1930; ^{1,2}LACM	x	x	Galapagos Ids. (Finet, 1991)	x
492	*Modulus disculus* (Philippi)	Panamic	^{1,2}LACM	x	x	---	x
	CERITHIIDAE						
548	*Bittium nicholsi* Bartsch	Panamic	^{1}Strong & Hanna, 1930	x	-	---	x

510	*Cerithium maculosum* Kiener	Panamic	[1,2]Strong & Hanna, 1930; [1,2]LACM	x	x	Cocos Id. (Montoya, 1983); Galapagos Ids. (Finet, 1991)	x
516	*Cerithium uncinatum* (Gmelin)	Panamic	[2]Bartsch & Rehder, 1939; [2]LACM; [2]USNM	-	x	Galapagos Ids. (Finet, 1991)	x
506	*Rhinoclavis gemmata* (Hinds)	Panamic	[2]Bartsch & Rehder, 1939; [1,2]Houbrick, 1978; [1,2]LACM; [1,2]USNM	x	x	Galapagos Ids. (Finet, 1991)	x
	HIPPONICIDAE						
765	*Hipponix grayanus* Menke	Panamic	[1,2]LACM	x	x	Galapagos Ids. (Finet, 1991); Cocos Id. (Montoya, 1983)	x
766	*Hipponix antiquatus panamensis* C. B. Adams (=*H. cranioides* Carpenter; =*H. fimbriatus* Bartsch & Rehder)	Panamic (subspecies)	[1,2]LACM	x	x	Clipperton Id. (Bartsch & Rehder, 1939); Galapagos Ids. (Finet, 1991)	x
---	*Hipponix tumens* Carpenter	Californian	[1]Strong & Hanna, 1930	x	-	---	x
767	*Pilosabia pilosa* (Deshayes) (=*H. barbatus* Sowerby)	?Circum-tropical	[2]Strong & Hanna, 1930; [2]AMNH; [1,2]LACM	x	x	Clipperton Id. (Emerson, 1994); Galapagos Ids. (Finet, 1991); Cocos Id. (Montoya, 1983)	x
	CALYPTRAEIDAE						
808	*Crepidula aculeata* (Gmelin)	Cosmopolitan	[1]Strong & Hanna, 1930	x	x	Galapagos Ids. (Finet, 1991)	x
	NATICIDAE						
874	*Polinices caprae* (Philippi)	Panamic	[2]LACM	-	x	Galapagos Ids. (Marincovich, 1977)	x
882	*Polinices uber* (Valenciennes)	Panamic	[1]LACM	x	-	Galapagos Ids. (Marincovich, 1977)	x
884	*Natica idiopoma* Pilsbry & Lowe	Panamic	[1]LACM	x	-	Galapagos Ids. (Marincovich, 1977); Cocos Id. (Shasky, 1989b)	x
	STROMBIDAE						
607	*Strombus gracilior* Sowerby	Panamic	[1]LACM	x	-	---	x
	CYPRAEIDAE						
919	*Cypraea albuginosa* Gray	Panamic	[2]Strong & Hanna, 1930; [2]LACM; [2]SBMNH	-	x	Clipperton Id., Cocos Id., Galapagos Ids. (Cate, 1969)	x
927	*Cypraea arabicula* (Lamarck)	Panamic	[1,2]LACM	x	x	Clipperton Ids.; Galapagos Ids. (Cate, 1969)	x
922	*Cypraea isabellamexicana* Stearns	Panamic	[2]Strong & Hanna, 1930; [1,2]Burgess, 1985; [2]ANSP; [1]USNM; [2]LACM	x	x	Clipperton Id.; Galapagos Ids. (Cate, 1969); Cocos Id. (Montoya, 1983)	x
	TRIVIIDAE						
905	*Trivia californiana* (Gray)	Californian-Panamic	[1,2]LACM	x	x	---	x
909	*Trivia sanguinea* (Sowerby)	Panamic	[1]LACM	x	-	Galapagos Ids. (Finet, 1991)	x
	TONNIDAE						
942	*Malea ringens* (Swainson)	Panamic	[2]CAS	-	x	Clipperton Id. (Hertlein & Emerson, 1957); Galapagos Ids. (Finet, 1991)	x
	CASSIDAE						

949	*Casmaria vibexmexicana* (Stearns)	Panamic	[2]LACM	-	x	Galapagos Ids. (Finet, 1991)	x
946	*Cypraecassis tenuis* (Wood)	Panamic	[1]Strong & Hanna, 1930	x	-	Cocos Id. (Shasky, 1989b); Galapagos Ids. (Finet, 1991)	x
948	*Semicassis centiquadrata* (Valenciennes)	Panamic	[1]Strong & Hanna, 1930	x	-	Galapagos Ids. (Finet, 1991); Cocos Id. (Emerson & Old, 1964)	x
	RANELLIDAE						
954	*Cymatium corrugatum amictum* (Reeve)	Circum-tropical (subspecies)	[1]LACM	x	-	Cocos Id., Galapagos Ids. (Emerson, 1991)	x
959	*Cymatium pileare macrodon* (Valenciennes)	Circum-tropical (subspecies)	[2]Emerson & Old, 1963; [3]SBMNH	-	x	Cocos Id. (Montoya, 1983); Clipperton Id.; Galapagos Ids. (Emerson, 1991)	x
	PERSONIDAE						
963	*Distorsio decussata* (Valenciennes)	Panamic	[2]LACM	-	x	---	x
	JANTHINIDAE						
687	*Janthina globosa* Blainville	Pelagic, circum-tropical	[1]ANSP	x	-	Clipperton Id. (Salvat & Ehrhardt, 1970)	x
	BURSIDAE						
964	*Bursa corrugata corrugata* (Perry) (=*B. caelata* (Broderip))	Circum-tropical	[2]Keen, 1971	-	x	Galapagos Ids. (Finet, 1991); Cocos Id. (Montoya, 1983)	x
966	*Bufonaria nana* (Broderip & Sowerby)	Panamic	[1,2]Strong & Hanna, 1930	x	x	Cocos Id. (Montoya, 1983)	x
---	*Bursa granularis* (Röding)	Circum-tropical	[2]SBMNH	-	x	Clipperton Id. (Emerson, 1991); Cocos Id. (Shasky, 1983)	x
	EULIMIDAE						
754	*Niso imbricata* Sowerby	Panamic	[1]Emerson, 1971; [1]LACM	x	-	Galapagos Ids. (Emerson, 1971)	x
	MURICIDAE						
1063	*Babelomurex costata* (Blainville)	Panamic	[2]Strong & Hanna, 1930	-	x	Galapagos Ids. (Finet, 1991)	x
1068	*Babelomurex hindsii* (Carpenter)	Panamic	[1,2]LACM	x	x	Galapagos Ids. (Finet, 1991)	x
1064	*Coralliophila nux* (Reeve)	Panamic	[1,2]Strong & Hanna, 1930	x	x	Galapagos Ids. (Finet, 1991)	x
1065	*Coralliophila orcuttiana* Dall	Panamic	[1]LACM	x	-	Galapagos Ids. (Finet, 1991)	x
1066	*Corallophila parva* (E. A. Smith)	Panamic	[2]LACM	-	x	Galapagos Ids. (Finet, 1991)	x
1061	*Coralliophila violacea* (Kiener)	Indo-Pacific	[1,2]Strong & Hanna, 1930	x	x	Clipperton Id.; Galapagos Ids. (Emerson, 1991); Cocos Id. (Shasky, 1983)	x
990	*Murexiella lappa* (Broderip) (=*M. radicata* (Hinds))	Panamic	[1,2]Strong & Hanna, 1930	x	x	Galapagos Ids. (Finet, 1991)	x
1003	*Hexaplex radix* (Gmelin)	Panamic	[1]Strong & Hanna, 1930	x	-	---	x
----	*Ocenebra circumtexta* Stearns	Californian	[1]Strong & Hanna, 1930	x	-	---	x
1088	*Plicopurpura patula pansa* (Gould)	Panamic (subspecies)	[1,2]Strong & Hanna, 1930; [2]AMNH; [1,2]LACM	x	x	Cocos Id. (Emerson & Old, 1964); Galapagos Ids. (Finet, 1991)	x

1071	*Quoyula madreporarum* (Sowerby)	Indo-Pacific	[2]Hertlein, 1937; [2]LACM	-	x	Clipperton Id. (Emerson, 1991); Galapagos Ids. (Finet, 1991)	x
1076	*Thais haemastoma biserialis* (Blainville)	Panamic (subspecies)	[1,2]LACM	x	x	Galapagos Ids. (Finet, 1991); Cocos Id. (Montoya, 1983)	x
1080	*Thais planospira* (Lamarck)	Panamic	[1,2]Strong & Hanna, 1930; [2]AMNH; [1]ANSP; [1,2]LACM; [2,3]SBMNH; [2]Stearns, 1893	x	x	Clipperton Id. (Emerson, 1994); Cocos Id. (Emerson & Old, 1964); Galapagos Ids. (Hertlein & Emerson, 1957)	x
1074	*Mancinella speciosa* (Valenciennes)	Panamic	[2]AMNH; [2]LACM	-	x	Clipperton Id. (Hertlein & Allison, 1960); Cocos Id. (Montoya, 1983); Galapagos Ids. (Finet, 1991)	x
	BUCCINIDAE						
968	*Colubraria jordani* Strong (not "*Epidromus nitidulus*" Strong & Hanna, 1930)	Endemic	[2]Strong & Hanna, 1930; [2]Strong, 1938	-	x	---	-
1292	*Nassarius catallus* (Dall)	Panamic	[1,2]LACM	x	x	Clipperton Id. (Hertlein & Emerson, 1953); Galapagos Ids. (Finet, 1991)	x
1295	*Nassarius nassiformis* (Lesson) (=*N. corpulentus* (C. B. Adams))	Panamic	[1,2]LACM	x	x	Galapagos Ids. (Shasky, 1989a)	x
1304	*Nassarius insculptus* (Carpenter)	Californian-Panamic	[2]LACM	-	x	---	x
1321	*Nassarius tiarula* (Kiener)	?Californian-Panamic	[2]LACM	-	x	---	x
1314	*Nassarius versicolor* (C. B. Adams)	Panamic	[1]LACM	x	-	Galapagos Ids. (Cernohorsky, 1975)	x
	FASCIOLARIIDAE						
1334	*Latirus socorroensis* Hertlein & Strong (=*L. clippertonensis* Hertlein & Allison, *fide* Keen, 1971)	Panamic (insular endemic)	[4]Keen, 1971; [2]AMNH; [2]ANSP; [2]LACM; [1,2]SBMNH; [1,2]Strong & Hanna, 1930, as: *L. concentricus* (Reeve)	x	x	Clipperton Id. (Keen, 1971)	-
	COLUMBELLIDAE						
1175	*Costoanachis coronata* (Sowerby)	Panamic	[2]Strong & Hanna, 1930	-	x	---	x
1155	*Columbella fuscata* Sowerby	Panamic	[1,2]Strong & Hanna, 1930	x	x	Galapagos Ids. (Finet, 1991)	x
1160	*Columbella socorroensis* Shasky	Endemic	[2]Shasky, 1970; [2]AMNH; [1]ANSP; [2]LACM; [1,2,3]SBMNH	x	x	---	-
----	*Mitrella carinata* (Hinds)	Californian	[1]Strong & Hanna, 1930	x	-	---	x
1239	*Mitrella ocellata guttata* (Sowerby)	Panamic (subspecies)	[1,2]Strong & Hanna, 1930; [2]Bartsch & Rehder, 1939	x	x	Galapagos Ids. (Finet, 1991); Cocos Id. (Montoya, 1983)	x
	OLIVIDAE						
1377	*Olivella dama* (Wood)	Panamic	[2]Bartsch & Rehder, 1939	-	x	---	x
1379	*Olivella graciis* (Broderip & Sowerby)	Panamic	[1]Strong & Hanna, 1930	x	-	Galapagos Ids. (Finet, 1991)	x

	MARGINELLIDAE						
----	*Granula subtrigona* (Carpenter)	Californian	^{1,2}Strong & Hanna, 1930	x	x	---	x
1417	*Granulina margaritula* (Carpenter)	Aleutian-Panamic	^{1}Strong & Hanna, 1930	x	-	Galapagos Ids. (Keen, 1971)	x
1408	*Volvarina taeniolata taeniolata* Mörch (=*Marginella californica* Tomlin)	Californian-Panamic	^{1,2}Strong & Hanna, 1930; ^{2}CAS	x	x	Galapagos Ids. (J. Hertz, 1977)	x
	MITRIDAE						
1429	*Mitra tristis* Broderip	Panamic	^{2}Strong & Hanna, 1930; ^{2}LACM	-	x	Galapagos Ids. (Finet, 1991); Cocos Id. (Montoya, 1983)	x
	CONIDAE						
1489	*Conus brunneus* Wood	Panamic	^{1}Strong & Hanna, 1930; ^{2}LACM; ^{1}ANSP	x	x	Clipperton Id. (Hanna & Strong, 1949); Cocos Id. (Montoya, 1983); Galapagos Ids. (Hanna, 1963)	x
1491	*Conus diadema* Sowerby	Panamic	^{4}Hanna, 1963; ^{2}AMNH; ^{2,3}LACM; ^{1,2}SBMNH	x	x	Clipperton Id. (Allison, 1959); Cocos Id. (Montoya, 1983); Galapagos Ids. (Hanna, 1963)	x
1493	*Conus gladiator* Broderip	Panamic	^{1,2}Strong & Hanna, 1930	x	x	Galapagos Ids. (Finet, 1991); Cocos Id. (Montoya, 1983)	x
1514	*Conus nux* Broderip	Panamic	^{2}AMNH; ^{2}LACM	-	x	Galapagos Ids. (Hanna, 1963); Clipperton Id. (Perrin, 1977)	x
1500	*Conus purpurascens* Sowerby	Panamic	^{1}Strong & Hanna, 1930; ^{1,2}LACM; ^{1}ANSP; ^{1}USNM; ^{1,2}SBMNH	x	x	Clipperton Id. (Hertlein & Emerson, 1957); Cocos Id. (Montoya, 1983); Galapagos Ids. (Finet, 1991)	x
1512	*Conus tessulatus* Born	Indo-Pacific	^{1}Hanna, 1963; ^{1}LACM; ^{2}Shasky collection	x	x	Clipperton Id. (Emerson, 1991); Cocos Id., Galapagos Ids. (Shasky, 1989a)	x
1495	*Conus tiaratus* Sowerby	Panamc	^{1,2}Hanna, 1963; ^{1,2}LACM; ^{2}AMNH; ^{1}ANSP; ^{2}SBMNH	x	x	Clipperton Id. (Emerson, 1994); Cocos Id. (Hanna, 1963); Galapagos Ids. (Finet, 1991)	x
----	*Conus xanthicus* Dall	Panamic	^{1}McLean & Nybakken, 1979; ^{1}LACM	x	-	Galapagos Ids. (McLean & Nybakken, 1979)	x
	TEREBRIDAE						
1572	*Hastula albula* (Menke)	Indo-Pacific	^{1,2}Bratcher & Burch, 1971; ^{1,2}LACM	x	x	---	x
1532	*Terebra crenulata* (Linné)	Indo-Pacific	^{1,2}LACM	x	x	Clipperton Id. (Emerson, 1991); Cocos Id. (Montoya & Kaiser, 1988)	-
1537	*Terebra frigata* Hinds	Panamic	^{2}LACM	-	x	Galapagos Ids. (Finet, 1991)	x
1549	*Terebra maculata* (Linné) (=*T. roosevelti* Bartsch & Rehder)	Indo-Pacific	^{2}Bartsch & Rehder, 1939; ^{2}LACM	-	x	Cipperton Id. (Emerson, 1991); Cocos Id. (Montoya & Kaiser, 1988)	x
1554	*Terebra ornata* Gray	Panamic	^{2}AMNH	-	x	Galapagos Ids. (Finet, 1991); Cocos Id. (Montoya & Kaiser, 1988)	x
1567	*Terebra stohleri* Bratcher & Burch	Panamic	^{2}Keen, 1971; ^{2}LACM	-	x	Galapagos Ids. (Bratcher & Cernohorsky, 1987)	x

1566	*Terebra strigata* Sowerby	Panamic	[1]LACM	x	-	Galapagos Ids. (Finet, 1991); Cocos Id. (Montoya & Kaiser, 1988)	x
	TURRIDAE						
1642	*Bellaspira clarionensis* McLean & Poorman	Endemic	[1]McLean & Poorman, 1970; [1]LACM	x	-	---	-
	ARCHITECTONICIDAE						
428	*Heliacus areola bicanaliculatus* (Valenciennes) (see Bieler, 1993:196)	Indo-Pacific	[1]Strong & Hanna, 1930	x	-	Galapagos Ids. (Bieler, 1993)	x
	PYRAMIDELLIDAE						
1971	*Evalea socorroensis* (Dall & Bartsch)	Endemic	[2]Keen, 1971	-	x	---	-
	BULLIDAE						
2236	*Bulla punctulata* A. Adams	Panamic	[2]Bartsch & Rehder, 1939	-	x	Galapagos Ids. (Sphon & Mulliner, 1972); Cocos Id. (Emerson & Old, 1964)	x
	TYLODINIDAE						
2311	*Tylodina fungina* Gabb	Californian-Panamic	[4]CAS	?	?	Galapagos Ids. (Finet, 1991)	x
	TRIMUSCULIDAE						
2427	*Trimusculus reticulatus* (Sowerby)	Californian-Panamic	[2]Strong & Hanna, 1930	-	x	---	x
POLYPLACOPHORA (N = 8 species)							
	ISCHNOCHITONIDAE						
17	*Ischnochiton muscarius* (Reeve)	Panamic	[2]Ferreira, 1983	-	x	---	x
20	*Ischnochiton rugulatus* (Sowerby)	Indo-Pacific (Hawaiian Ids.)	[2]Ferreira, 1983	-	x	Galapagos Ids. (Smith & Ferreira, 1977)	x
--	*Stenoplax corrugata* (Carpenter)	Californian-Panamic	[1]Ferreira, 1983; [1]LACM	x	-	---	x
--	*Lepidozona clarionensis* Ferreira	Endemic	[1,2]Ferreira, 1983; [1]ANSP; [1]USNM; [1]LACM	x	x	---	-
--	*Lepidozona rothi* Ferreira	Panamic	[1]Ferreira, 1983; [1]LACM	x	-	Cocos Id. (Ferreira, 1987)	x
--	*Chaetopleura lurida* (Sowerby) (=*C. scabricula* (Sowerby), *fide* Kaas & Van Belle, 1987)	Panamic	[2,3]Ferreira, 1983	-	x	---	x
--	*Lepidochitona keepiana* Berry	Californian	[2]Ferreira, 1983	-	x	---	x
	CHITONIDAE						
3	*Chiton articulatus* Sowerby	Panamic	[1,2,3]Ferreira, 1983; [2]AMNH; [2]ANSP; [1,2]SBMNH; [2]CAS	x	x	---	x

THE SANTA ROSA ISLAND DIVE TRIP -- 1994

LARRY BUCK

18440 Portofino Drive, Del Mar, CA 92014, USA

I'm a little late in reporting on this year's annual dive trip. However, in case you wondered, our August dive trip on the dive boat **Peace** out of Ventura Harbor was better than ever. The twenty-six of us who went along enjoyed prime rib, home-made peach ice cream, free shirts, diving at Santa Rosa Island and the infamous hot tub. The newcomers and the "oldcomers" enjoyed each other's company--two days is not long enough for people to grate on each other's nerves. Weather permitting, each year's trip is almost a guaranteed success.

Some noteworthy sightings were: *Pteropurpura trialata* (Sowerby, 1841) at Santa Rosa Island by Kim Hutsell; *Pecten diegensis* Dall, 1898 at Santa Rosa and Santa Cruz Islands, lots of *Fusinus kobelti* (Dall, 1877), and a very large *Erato vitellina* Hinds, 1844, at Santa Rosa Island by Chuck Reitz, a monster-sized lingcod by Larry Catarius at Santa Rosa Island; and I found a record-sized *Ceratostoma nuttalli* (Conrad, 1837), at Santa Rosa Island.

We seem to enjoy Santa Rosa Island the most. It's a large island with many dive sites. Sometimes I think that it just can't keep getting better each year, but then it does. If you're interested, see me for a space on next summer's charter. Good diving.

IN MEMORIAM

VIRGINIA HANSELMAN

With sadness, we report the passing in October of longtime member Virginia Hanselman. Virginia was a Club member and booster for over thirty years. She served as corresponding secretary in 1971, was on the original committee for **The Festivus**, wrote several articles, and it was at the Hanselman home that the publication was collated and prepared for mailing during its early years. Virginia was also a participant at the meeting in which the Western Society of Malacologists was begun. She is survived by her husband, George, daughter Joan Wong, four grandsons and two great-grandsons.

ANNITA LEVINE

We have received notification of the passing of Annita Levine. Annita was a corresponding member of the Club since 1989 and often visited here in the winters. She and her husband donated the Morris Levine Collection to the San Diego Natural History Museum and it was her generous donation in 1989 that made possible the one-time Anthony D'Attilio Student Research Grant in Malacology.

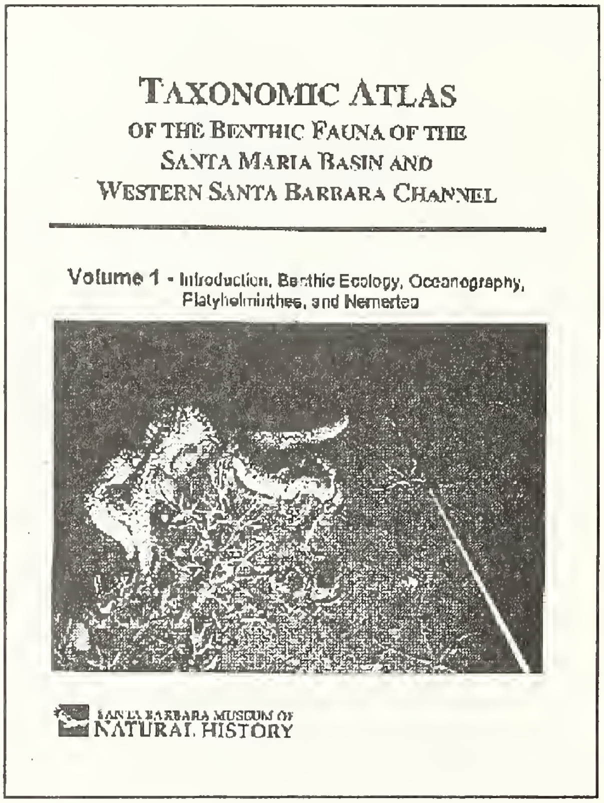
1995 LOW TIDES FOR THE NORTHERN GULF OF CALIFORNIA

The entries below show periods of low tides of -4.0 feet and below. The times of low tides are given in Mountain Standard Time. To correct for San Felipe, subtract one hour from listed times which are for Puerto Peñasco (San Felipe is on Pacific Standard Time). Tides below the midriff of the Gulf cannot be estimated using these entries.

Date	Tides	Date	Tides	Date	Tides	Date	Tides
Jan. 1	-5.7 ft at 8:00 PM	Mar. 17	-4.0 ft at 8:00 AM	May 16	-4.8 ft at 8:45 AM	Nov. 22	-5.3 ft at 7:30 PM
Jan. 2	-4.7 ft at 8:40 PM	Mar. 18	-4.2 ft at 8:30 AM	June 12	-4.4 ft at 7:00 AM	Nov. 23	-5.5 ft at 8:00 PM
Jan. 28	-4.0 ft at 7:00 PM	Mar. 19	-4.0 ft at 8:50 AM	June 13	-5.2 ft at 7:30 AM	Nov. 24	-4.1 ft at 9:00 PM
Jan. 29	-4.5 ft at 7:20 PM	Apr. 14	-4.1 ft at 7:15 AM	June 14	-4.4 ft at 8:10 AM	Dec. 20	-4.3 ft at 6:50 PM
Jan. 30	-5.5 ft at 8:00 PM	Apr. 15	-5.4 ft at 7:45 AM	July 12	-4.1 ft at 7:40 AM	Dec. 21	-5.7 ft at 7:45 PM
Jan. 31	-4.5 ft at 8:30 PM	Apr. 16	-5.8 ft at 8:00 AM	July 13	-4.0 ft at 8:30 AM	Dec. 22	-5.7 ft at 8:15 PM
Feb. 15	-4.0 ft at 8:00 PM	Apr. 17	-5.2 ft at 8:40 AM	Aug. 10	-4.0 ft at 7:45 AM	Dec. 23	-4.3 ft at 9:00 PM
Feb. 28	-4.2 ft at 7:45 PM	May 13	-4.1 ft at 7:00 AM	Oct. 24	-4.0 ft at 8:00 PM		
Mar. 1	-4.0 ft at 8:00 AM	May 14	-5.3 ft at 7:10 AM	Oct. 25	-4.0 ft at 8:40 PM		
Mar. 1	-4.0 ft at 8:00 PM	May 15	-5.7 ft at 8:00 AM	Nov. 21	-4.1 ft at 6:45 PM		

BOOK NEWS

The Santa Barbara Museum of Natural History recently announced a new monographic series on the taxonomy of the marine invertebrates of Southern California, the **Taxonomic Atlas of the Benthic Fauna of the Santa Maria Basin and the Western Santa Barbara Channel.** This 14 volume series describes and illustrates the marine invertebrates in the Point Conception region of Southern California (35°N) at depths from 50 to 1000 meters. Each volume will include an introduction to the faunal group, collection and preparation methodology, glossary of terms, as well as descriptions, distributions and illustrations of all species. Volume 1 contains the Introduction, Benthic Ecology, Oceanography, Platyhelminthes and Nemertea; Volume 2: The Porifera; Volume 3: Cnidaria; Volumes 4 to 7: Annelida; Volumes 8 and 9: Mollusca; Volumes 10 to12: Arthropoda; Volume 13: Bryozoa; and Volume 14: remaining taxa and master species list. Volumes 1, 2, and 4 have already been issued. Volumes 8 and 9 will probably be available in February, with Volume 8 covering the prosobranchs and opisthobranchs, and Volume 9 the aplacophorans, chitons, bivalves, and cephalopods. The volumes are softbound and vary in price. For further information contact: Dept. of Invertebrate Zoology, Santa Barbara Museum of Natural History, 2559 Puesta del Sol Road, Santa Barbara, CA 93105, USA or call 805-582-4711.



TAXONOMIC ATLAS
OF THE BENTHIC FAUNA OF THE
SANTA MARIA BASIN AND
WESTERN SANTA BARBARA CHANNEL

Volume 1 - Introduction, Benthic Ecology, Oceanography, Platyhelminthes, and Nemertea

SANTA BARBARA MUSEUM OF
NATURAL HISTORY

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THE FESTIVUS

A publication of the San Diego Shell Club

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Annual dues are payable to San Diego Shell Club. Membership (includes family): $12.00; Overseas (surface mail): $15.00; Overseas (air mail): $30.00. Address all correspondence to the San Diego Shell Club, Inc., c/o 3883 Mt. Blackburn Ave., San Diego, CA 92111

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Meeting date: third Thursday, 7:30 PM
Room 104, Casa Del Prado, Balboa Park

PROGRAM

Tahiti Travelogue

Hugh Bradner will give a slide presentation which will be a composite of the Bradners' many trips to French Polynesia, the latest to Moorea in 1994. The Bradners will also donate a Tahitian shell for a special drawing.

Shells of the month: Ovulidae
Meeting date: February 16, 1995

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CLUB NEWS

From the Minutes
San Diego Shell Club Meeting--January 20, 1995

The meeting was called to order at 7:35 p.m. by President Kay Klaus. New officers of the Board and committee chairpersons were introduced. Upcoming Club events announced were: trip to El Golfo (March 17-19), Auction/Potluck (April 22), the Bizarre Bazaar (May 7) and the COA Convention in June.

Treasurer Margaret Mulliner mentioned that she is now accepting dues. She also reported that the Club had received the second volume of **Australian Marine Shells** by Barry Wilson.

Jules Hertz shared information on incoming publications. He also showed the design for the new Club t-shirts ($15) and sweatshirts ($25). He then mentioned that a survey was being taken to help in ordering. The shirts will be available in gray and in black.

Kay reported that the Club needs volunteers for a Club Botanical Garden Foundation representative to attend monthly meetings, a host/hostess to coordinate refreshments for meetings and a phone tree person to make reminder calls for K-Z names. Vi Thomas and Larry Buck will continue to assist with the phoning. Bill Romer has accepted the position of publicity chairperson.

Kim Hutsell introduced the guest speaker for the evening. Mike Johnson presented a very interesting slide program on our "two" oceans--the ancient ocean which is now the desert to the east of us and the modern ocean. His slides showed the fascinating and diverse natural life that the desert, shoreline, and deep waters possess.

After the minutes of the last meeting, as published in **The Festivus**, were accepted, the shell drawing was conducted with John Bishop having the winning number. The meeting was adjourned at 8:30 p.m. Everyone then enjoyed the refreshments provided by Kay Klaus and Hugh Bradner and socialized and enjoyed looking at the various shells brought in by Kim Hutsell and Tom Knapik, among others.

Silvana Vollero

The Auction is Coming!

The Club's annual auction/potluck will be held on Saturday evening, April 22nd at the Clubhouse at Wes Farmer's condo. Wes has most generously offered to host the event again. Further details in the March issue with a map in the April issue.

It is not too early to prepare your shells for donation. There are only two meetings before the auction and the auction is only as good as the shells that have been donated. Be generous, remembering that the auction provides the major funding for Club projects such as **The Festivus**, donations to scientific organizations, prizes for the Science Fair and Club library purchases. If you will not be able to bring your shell donation to a Club meeting, contact a board member to arrange for pickup.

Two Books Missing from the Club Library

Librarian Margaret Mulliner and Kim Hutsell have done an inventory of the Club's library holdings. Some books have been out too long and letters have been sent to request immediate return of those volumes. Books are on loan for only one month.

Most disturbing, however, is that two books cannot be traced. **American Seashells, 2nd edition** (1974) by R. Tucker Abbott and MacFarland's (1966) **Studies of Opisthobranchiate Mollusks of the Pacific Coast of North America** (the text not the plates) are missing. If you have either of these books, please contact the librarian (488-2701).

A Trip to El Golfo

Some members of the Club are planning to go to El Golfo in the northern Sea of Cortez for the low tides from March 17th to the 19th. (The tide calendar was published in the January issue of **The Festivus**.) Members have visited this area before and have enjoyed their stays. If you are interested in joining others who are planning to go, contact Larry Buck (792-5404) for further information.

The Bizarre Bazaar

The sixth annual Bizarre Bazaar (shell bazaar) will be held on Sunday, May 7th in the Hertz's garden beginning at 1:00 p.m. Save the date. Details later.

NEW DISTRIBUTIONAL INFORMATION FOR PANAMIC PROVINCE RISSOOIDEA (MOLLUSCA: GASTROPODA)

CAROL SKOGLUND[1] and ROBERT KOCH[2]

Associates, Santa Barbara Museum of Natural History
2559 Puesta del Sol Road, Santa Barbara, California 93105, USA

INTRODUCTION

Keen (1971) gave the known distribution for most shells in the Panamic Province. Skoglund (1992), using the same geographic limits proposed by Keen, brought published range extension information for each species up to date.

Numerous taxonomic changes have been made since Keen's treatise was published. These changes are listed in Skoglund (1992). **Bold** type was used by Skoglund and is used herein to indicate these changes and for new species not included in Keen's book. Where possible, the same numbering system has been used. Koch (1993) updated the geographical locations for Skoglund (1992).

Geographic and bathymetric distributions have been taken from material in the Skoglund (S.) and Koch (K.) collections. Some Caecidae distributions repeated herein were first cited by Lightfoot (1993a,b) from material in the Skoglund collection. Although Lightfoot made many changes in generic placement and species synonyms within the Caecidae, we have chosen to retain the arrangement in Keen (1971) as modified by Draper (1979) and Gemmell, Hertz & Myers (1980).

Several of the species listed have been found by us at many different localities outside of the presently published ranges, but only the most northern and/or southern distributional points are given. All citations are based on examination of specimens by both of us with agreement on identification of the species involved. All specimens were dead taken except as noted.

Family RISSOIDAE

241 *Rissoina (Rissoina) allemani* Bartsch, 1931. Include the Islas las Perlas, Panama, in distribution and extend distribution north to Playas del Coco, Guanacaste, Costa Rica. Depth: intertidal zone (K.).

242 *Rissoina (R.) axeliana* Hertlein & Strong, 1951. Extend distribution north to Isla San Pedro Nolasco (K.), and off Isla Danzante (S.), Gulf of California, Mexico. Depth: 3 to 90 m.

244 *Rissoina (R.) barthelowi* Bartsch, 1915. Extend distribution to off Bahía la Cholla, Sonora, and south to Bahía de las Banderas, Nayarit, Mexico. Depth: 7 to 20 m (S.).

246 *Rissoina (R.) burragei* Bartsch, 1915. Distribution confirmed to Puertecitos, Baja California, and Bahía la Cholla, Sonora, Mexico. Intertidal zone (S.).

--- ***Rissoina (R.) cerrosensis*** Bartsch, 1915. Extend distribution south to Bahía Magdalena, Baja California Sur (S.), to the upper Gulf of California at Estero Morua, Puerto Peñasco, Sonora (S., K.), and to La Cruz de Huanacaxtle, Bahía de las Banderas, Nayarit, Mexico (S.). Depth: intertidal zone, in drift, to 20 m.

248 *Rissoina (R.) clandestina* (C. B. Adams, 1852). Extend distribution north to off Punta San Felipe, Baja California (S.), and at Bahía la Cholla, Sonora, Mexico (S.), and south to Salinas, Guayas, Ecuador (K.). Depth: intertidal zone to 20 m.

252 *Rissoina (R.) expansa* Carpenter, 1865. Extend distribution north along the west coast of Baja

---

[1] Mailing address: 3846 E. Highland Ave. Phoenix, AZ 85018, USA
[2] Mailing address: 1215 West Seldon Lane, Phoenix, AZ 85021, USA

California to Bahía Playa Maria, Mexico, which is north of the Panamic Province (K.).

254 *Rissoina (R.) firmata* (C. B. Adams, 1852). Extend distribution north to Puerto Lobos, Cabo Tepoca, Sonora, Mexico (S.), and south to Salinas, Guayas, Ecuador (K.). Intertidal zone.

273 *Rissoina (R.) woodwardi* Carpenter, 1857. Include Puerto Peñasco, Sonora, Mexico, in distribution. Intertidal zone (S.).

275 ***Folinia** ericana* (Hertlein & Strong, 1951). Extend distribution north to off Cabo Tepoca, Sonora, and off Isla Smith, Bahía de los Angeles, Baja California, Mexico. Depth: 20 to 183 m (S.).

276 ***Folinia insignae*** (de Folin, 1867). Distribution confirmed to Estero Morua, Puerto Peñasco, Sonora, Mexico. In drift at high tide line (S.).

215 ***Lapsigyrus** mutans* (Carpenter, 1857). Extend distribution south to Bahía de Panama, Panama (S., K.). Synonym, *Alvania milleriana* Hertlein & Strong, 1951, was reported from Bahía Ballena, Costa Rica (Hertlein & Strong, 1951). Synonym, *Alvania contrerasi* Jordan, 1936, was reported from Bahía Magdalena, on the west coast of Baja California Sur (Jordan, 1936) and in the upper Gulf of California at Bahía la Cholla, Sonora, Mexico (Berry, 1958).

269 ***Schwartziella (Pandalosia)** porteri* (Baker, Hanna & Strong, 1930). Include Bahía Cuastecomate, Jalisco, Mexico, in distribution. Depth: 12 to 30 m (S.).

--- ***Stosicia*** sp. Possibly undescribed. Sayulita, Nayarit, and Barra de Navidad, Jalisco, Mexico. Depth: intertidal to 45 m (S.). Previously known distribution: tropical Indo-west Pacific, southern Australia and the Caribbean (Ponder, 1985). See Figure 1.

Family BARLEEIDAE

226 *Barleeia paupercula* (C. B. Adams, 1852). Extend distribution south to Salinas, Guayas, Ecuador. Depth: intertidal zone to 9 m (K.).

195 *Lirobarleeia electrina* (Carpenter, 1864). Extend distribution north along Baja California Sur, Mexico, to off Santispac, Bahía Concepción. Depth: 8 to 30 m (S.).

198 ***Lirobarleeia** granti* (Strong, 1938). Extend distribution south to off Barra de Navidad, Jalisco, Mexico. Depth: 3 to 45 m (S.). Synonym, *Alvania veleronis* Hertlein & Strong, 1939, was reported from off Isla Taboga, Bahía de Panama (Hertlein & Strong, 1939).

204 ***Lirobarleeia** ingrami* (Hertlein & Strong, 1951). Extend distribution north to Bahía Cuastecomate, Jalisco, Mexico. Depth: 12 to 30 m (S.).

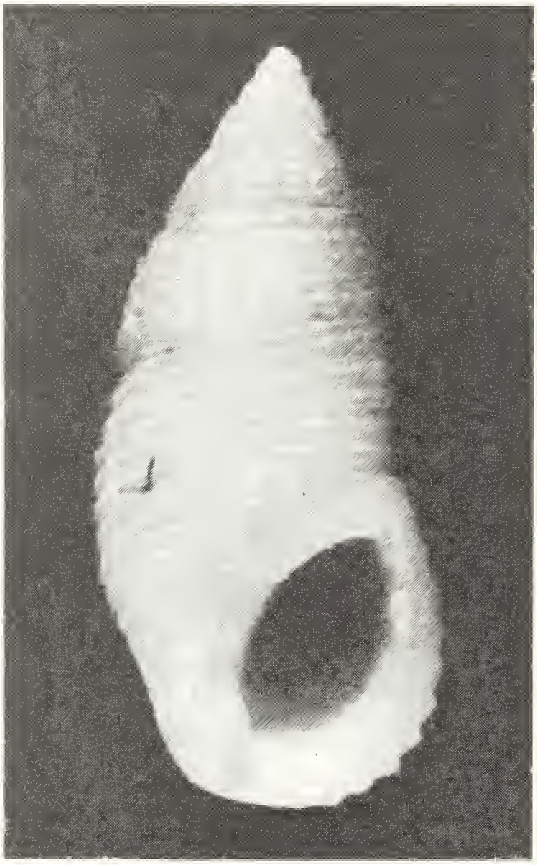

Figure 1. *Stosicia* sp. Length: 3.5 mm. Loc.: Sayulita, Nayarit, Mexico. Dead under rock at low tide. Leg. C. Skoglund. Photo: D. K. Mulliner.

Family ASSIMINEIDAE

229 *Assiminea californica* (Tryon, 1865). Confirm distribution in the upper Gulf of California along the Sonoran coast from Bahía la Cholla south to Puerto Lobos, Cabo Tepoca. Living on roots of grasses in estuary areas near the high tide line (S.).

Family **ELACHISINIDAE**

236 ***Elachisina** johnstoni* (Baker, Hanna & Strong, 1930). Extend distribution north in the Gulf of

California to off Isla Danzante on the Baja California side (K.) and to Estero Morua, Puerto Peñasco, Sonora, Mexico (S.). Depth: intertidal drift to 65 m. Ponder (1985) cites a depth of 9 to 23 m for living animals.

Family TRUNCATELLIDAE

284 *Truncatella californica* Pfeiffer, 1857. Extend distribution to near the head of the Gulf of California at Estero Morua, Puerto Peñasco, Sonora, Mexico. In drift at high tide line (S.).

Family VITRINELLIDAE

286 *Vitrinella (Vitrinella) goniomphala* Pilsbry & Olsson, 1952. Extend distribution to the west coast of Baja California Sur, Mexico, off Puerto San Carlos, Bahía Magdalena. Depth: 2 to 10 m (S.).

291 *Vitrinella (Vitrinellops) dalli* (Bartsch, 1919). Extend distribution south to Salinas, Guayas, Ecuador. Depth: Intertidal zone to 10 m (K.).

297 *Vitrinella (V.) martensiana* (Hertlein & Strong, 1951). Extend distribution north to La Cruz de Huanacaxtle, Bahía de las Banderas, Nayarit, Mexico. Depth: 7 to 20 m (S.).

305 *Aorotrema humboldti* (Hertlein & Strong, 1951). Distribution: off Puerto San Carlos, Bahía Magdalena, on the west coast of Baja California Sur (S.), north in the Gulf of California to Estero Morua, Puerto Peñasco, Sonora, Mexico (K.), and south to Salinas, Guayas, Ecuador (K.). Depth: intertidal zone to 60 m.

--- ***Cochliolepis cornis*** Hertz, Myers & Gemmell, 1992. Extend distribution to off Requeson, Bahía Concepción, Baja California Sur, Mexico. Depth: 8 to 20 m (S.).

306 *Cyclostremiscus (Cyclostremiscus) adamsi* (Bartsch, 1911). Extend distribution north to Bahía Drake, Puntarenas, Costa Rica. Depth: 9 to 24 m (K.).

308 *Cyclostremiscus (C.) bailyi* (Hertlein & Strong, 1951). Extend distribution south to Kobbe Beach, Canal Zone, Panama. Intertidal zone (S.).

309 *Cyclostremiscus (C.) balboa* Pilsbry & Olsson, 1945. Extend distribution south to Venado Beach, Canal Zone, Panama. Intertidal zone (S.).

311 *Cyclostremiscus (C.) bifrontia* (Carpenter, 1857). Extend distribution north to Cabo Tepoca, Sonora, and south to Tisate, Bahía de las Banderas, Nayarit, Mexico. Depth: intertidal zone to 30 m (S.).

313 *Cyclostremiscus (C.) coronatus* (Carpenter, 1857). Extend distribution south to off La Cruz de Huanacaxtle, Bahía de las Banderas, Nayarit, Mexico. Depth: 7 to 20 m (S.).

320 *Cyclostremiscus (C.) gordanus* (Hertlein & Strong, 1951). Extend distribution south to Bahía Santiago, Manzanillo, Colima, Mexico. Depth: 8 to 20 m (S.).

324 *Cyclostremiscus (C.) madreensis* (Baker, Hanna & Strong, 1938). Extend distribution north on Baja California Sur to off Santispac, Bahía Concepción (S.) and on the mainland north to Guaymas, Sonora (K.), and south to Barra de Navidad, Jalisco, Mexico (S.). Depth: 8 to 66 m.

329 *Cyclostremiscus (C.) panamensis* (C. B. Adams, 1852). Confirm distribution to Punta Mita, Bahía de las Banderas, Nayarit, Mexico. In drift at high tide line (S.).

330 *Cyclostremiscus (C.) parvus* (C. B. Adams, 1852). Extend distribution south to Salinas, Guayas, Ecuador. Depth: drift line to 10 m (K.).

331 *Cyclostremiscus (C.) pauli* Pilsbry & Olsson, 1952. Extend distribution north to off Playa Tamarindo, Bahía Tamarindo, Guanacaste, Costa Rica. Depth: 6 to 15 m (K.).

--- ***Cyclostremiscus (C.) salvatierrensis*** Hertz, Myers & Gemmell, 1992. Include off Cabo Tepoca, Sonora, Mexico, in distribution. Depth: 20 to 30 m (S.).

337 *Cyclostremiscus (C.) spiceri* (Baker, Hanna & Strong, 1938). Extend distribution north on mainland Mexico to Bahía la Cholla, Sonora. Intertidal zone (S.).

356 *Lydiphnis (Cymatopteryx) mariae* (Baker, Hanna & Strong, 1938). Extend distribution north to off Punta San Pedro, Sonora (K.), and south to Bahía Cuastecomate, Jalisco (S.), Mexico. Depth: intertidal zone to 30 m.

362 *Parviturboides monile* (Carpenter, 1857). Extend distribution north to Estero Morua, Puerto Peñasco, Sonora, Mexico (S.), and south to Salinas, Guayas, Ecuador (K.). Depth: drift line to 5 m.

365 *Solariorbis (Solariorbis) ametabolus* Pilsbry & Olsson, 1952. Extend distribution north to off Punta San Felipe, Baja California, Mexico. Depth: 15 to 20 m (S.).

367 *Solariorbis (S.) bakeri* (Hertlein & Strong, 1939).

Extend distribution north to off Punta Arco, Guaymas, Sonora (S.) and off Bahía Concepción, Baja California Sur, Mexico (S.), and south to off Salinas, Guayas, Ecuador (K.) Depth: 6 to 60 m.

368 *Solariorbis (S.) concinnus* (C. B. Adams, 1852). Extend distribution north to off Bahía la Cholla, Sonora, Mexico. Depth: 6 to 16 m (S.).

372 *Solariorbis (S.) hypolius* Pilsbry & Olsson, 1952. Include Guaymas, Sonora, Mexico, in distribution. Depth: 24 to 37 m (K.).

373 *Solariorbis (S.) miguelensis* Pilsbry & Olsson, 1952. Include Bahía de los Angeles, Baja California Sur (S.), on the west side of the Gulf of California, and Estero Morua, Puerto Peñasco, Sonora (K.), Mexico, on the east side of the Gulf. Depth: 7 to 60 m.

377 *Solariorbis (S.) pyricallosus* (Carpenter, 1857). Extend distribution north to off Bahía la Cholla, Sonora, Mexico, and south to Kobbe Beach, Canal Zone, Panama. Depth: intertidal zone to 16 m (S.).

379 *Solariorbis (Eulerema) pellucidus* Pilsbry & Olsson, 1952. Extend distribution north to Estero Morua, Puerto Peñasco, Sonora, Mexico. In drift at high tide line (S.).

380 *Solariorbis (Hapalorbis) carianus* Pilsbry & Olsson, 1952. Extend distribution north to Bahía de Panama, Panama (S., K.).

386 *Solariorbis (H.) pacificus* Pilsbry & Olsson, 1952. Extend distribution north to Playa Novillero, Nayarit, Mexico. Depth: 8 to 15 m (S.).

396 *Teinostoma (Esmeralda) esmeralda* Pilsbry & Olsson, 1945. Extend distribution north to Bahía de Panama, Panama (K.).

398 *Teinostoma (Idioraphe) narina* Pilsbry & Olsson, 1945. Extend distribution north to Bahía de Panama, Panama (K.).

403 *Teinostoma (Pseudorotella) herbertianum* Hertlein & Strong, 1951. Extend distribution north to off Bahía la Cholla, Sonora, Mexico. Depth: 6 to 16 m (S.).

404 *Teinostoma (P.) lampetes* Pilsbry & Olsson, 1952. Extend distribution north to off La Cruz de Huanacaxtle, Bahía de las Banderas, Nayarit, Mexico. Depth: 7 to 20 m (S.).

406 *Teinostoma (P.) millepunctatum* Pilsbry & Olsson, 1945. Extend distribution north to Punta Mita, Bahía de las Banderas, Nayarit, Mexico. In drift at high tide line (S.).

410 *Teinostoma (P.) soror* Pilsbry & Olsson, 1945. Extend distribution north to off Bahía la Cholla, Sonora, Mexico. Depth: 6 to 16 m (S.).

411 *Teinostoma (P.) substriatum* Carpenter, 1857. Distribution: off Puerto San Carlos, Bahía Magdalena, Baja California Sur, north in the Gulf of California to off Cabo Tepoca, Sonora, and south to Bahía Cuastecomate, Jalisco, Mexico. Depth: 2 to 33 m (S.).

414 *Teinostoma (P.) zacae* Hertlein & Strong, 1951. Extend distribution north to off Bahía la Cholla, Sonora, and across the Gulf of California to north of Puertecitos, Baja California, Mexico. Depth: 6 to 16 m (S.). Although these shells are a match with the description and illustration, they do not appear to belong in *Teinostoma*.

419 *Anticlimax (Subclimax) occidens* Pilsbry & Olsson, 1952. Extend distribution south to Bahía de Panama, Panama (K.).

419a *Anticlimax (S.) willetti* Hertlein & Strong, 1951. Extend distribution north to Bahía la Cholla, Sonora, Mexico. Depth: 6 to 16 m (S.).

421 *Vitridomus fragilis* Pilsbry & Olsson, 1945. Extend distribution north to Playa Tamarindo, Bahía Tamarindo, Guanacaste, Costa Rica. Depth: 6 to 15 m (K.).

Family CAECIDAE

451 *Caecum (C.) bahiahondaense* Strong & Hertlein, 1939. Extend distribution south to Salinas, Guayas, Ecuador. Intertidal zone (K.).

--- ***Caecum (C.) californicum*** **Dall, 1835.** Extend distribution south to Cabo San Lucas, Baja California Sur, Mexico. Intertidal zone (S.).

452 *Caecum (C.) clathratum* Carpenter, 1857. Extend distribution north to Estero Morua, Puerto Peñasco, Sonora, Mexico, in drift at high tide line (S.), and south to Salinas, Guayas, Ecuador. Depth: intertidal zone to 9 m (K.).

454 *Caecum (C.) diminutum* C. B. Adams, 1852. Extend distribution south to Salinas, Guayas, Ecuador. Intertidal zone (K.).

455 *Caecum eburneum* C. B. Adams, 1852. Extend distribution north to Bahía la Cholla, Sonora, Mexico. Intertidal zone (S.).

457 *Caecum (C.) farcimen* Carpenter, 1857. Extend distribution north to Estero Morua, Puerto Peñasco, Sonora (S.,K.), and off Punta la Gringa, Bahía de los Angeles, Baja California, Mexico (S.). Depth: in drift at high tide line to 40 m, live.

463 *Caecum (C.) parvum* C. B. Adams, 1852. Extend distribution north to Estero Morua, Puerto Peñasco, Sonora, Mexico (S.), and south to Salinas, Guayas, Ecuador (K.). In drift at high tide line to 9 m.

464 *Caecum (C.) pygmaeum* C. B. Adams. 1852. Extend distribution north to Norse (Sandy) Beach, north of Puerto Peñasco, Sonora, Mexico (S.), and south to Salinas, Guayas, Ecuador (K.). Intertidal zone.

466 *Caecum (C.) richthofeni* Strong & Hertlein, 1939. Extend distribution north to Bahía Culebra, Guanacaste, Costa Rica. Depth: 16 to 17 m (K.)

467 *Caecum (C.) semilaeve* Carpenter, 1857. Include off Isla San Jorge, Sonora, Mexico, in distribution. Depth: 17 to 20 m (K.).

468 *Caecum (C.) subimpressum* Carpenter, 1857. Extend distribution north to Estero Morua, Puerto Peñasco, Sonora, Mexico. In drift at high tide line (S.).

489 *Caecum (Micranellum) lohri* (Strong & Hertlein, 1939). Extend distribution north to off Isla Smith, Bahía de los Angeles, Baja California, Mexico, and south to Kobbe Beach, Canal Zone, Panama. Depth: in drift at high tide line to 183 m (S.).

471 *Elephantulum carpenteri* (Bartsch, 1920). Extend distribution north to Estero Morua, Puerto Peñasco, Sonora, Mexico, and south to Venado Beach, Canal Zone, Panama. In drift at high tide line (S.).

472 *Elephantulum heptagonum* (Carpenter, 1857). Extend distribution to include the west coast of Baja California Sur off Puerto San Carlos, Bahía Magdalena (S.), and Estero Morua, Puerto Peñasco, Sonora (S., K.), Mexico. Depth: in drift at high tide line to 10 m.

478 *Elephantulum insculptum* (Carpenter, 1857). Extend distribution south to Salinas, Guayas, Ecuador. Intertidal (K.).

473 *Elephantulum liratocinctum* (Carpenter, 1857). Extend distribution to the west coast of Baja California Sur off Puerto San Carlos, Bahía Magdalena, live, then north to Bahía la Cholla, Sonora, Mexico (S.), and south to Salinas, Guayas, Ecuador (K.). Depth: intertidal to 10 m.

460 *Elephantulum mirificum* (de Folin, 1867). Distribution: off Isla Smith, Bahía de los Angeles, Baja California, to off Bahía la Cholla, Sonora, Mexico (S.), and south to Bahía Culebra, Guanacaste, Costa Rica (K.). Depth: 6 to 183 m (S.).

480 *Elephantulum subspirale* (Carpenter, 1857). Extend distribution north to off Puerto San Carlos, Bahía Magdalena, Baja California Sur, Mexico. Depth: 2 to 10 m (S.).

482 *Fartulum dextroversum* (Carpenter, 1857). Extend distribution to off Puerto San Carlos, Bahía Magdalena, Baja California Sur, and include off Bahía la Cholla, Sonora, Mexico. Depth: 2 to 16 m (S.).

483 *Fartulum glabriforme* (Carpenter, 1857). Extend distribution across the Gulf of California to Bahía la Cholla, Sonora, Mexico, and south to Venado Beach, Canal Zone, Panama (S.). Intertidal zone.

484 *Fartulum laeve* (C. B. Adams, 1852). Include Cabo San Lucas, Baja California Sur, Mexico, in distribution. Intertidal zone, live (S.).

--- ***Fartulum occidentale*** Bartsch, 1920. Extend distribution into the Gulf of California to off Punta la Gringa, Bahía de los Angeles, Baja California, Mexico. Depth: 20 to 40 m (S.).

485 *Fartulum reversum* (Carpenter, 1857). Extend distribution south to Bahía de Panama, Panama (S., K.).

486 *Fartulum teres* (Carpenter, 1857). Include off Bahía la Cholla, Sonora, Mexico, in distribution. Depth: 6 to 16 m (S.).

Family TORNIDAE

--- ***Macromphalina carinata*** (Pilsbry & Olsson, 1945). Extend distribution north to Estero Morua, Puerto Peñasco, Sonora, Mexico. Depth: in drift at high tide line to 10 m (S., K.).

787 *Macromphalina equatorialis* (Pilsbry & Olsson, 1945). Extend distribution north to the outer coast of Baja California Sur at Puerto San Carlos, Magdalena Bay, and to near the head of the Gulf of California at Estero Morua, Puerto Peñasco, Sonora, Mexico. Depth: intertidal to 10 m (S.).

--- ***Macromphalina foliniana*** (Pilsbry & Olsson, 1945). Extend distribution north to Kobbe Beach, Canal Zone, Panama. Intertidal zone (S.).

788 *Macromphalina hancocki* (Strong & Hertlein, 1939). Extend distribution north to Bahía la Cholla, Sonora, and off Isla Smith, Bahía de los Angeles, Baja California, Mexico. Depth: intertidal zone to 183 m (S.).

791 *Macromphalina peruviana* (Pilsbry & Olsson, 1945). Extend distribution north to Bahía Tenacatita, Jalisco, Mexico. Depth: 18 to 30 m (S.).

792 *Macromphalina philippi* (Pilsbry & Olsson, 1945). Extend distribution north to Bahía Tenacatita, Jalisco, Mexico. Depth: 18 to 30 m (S.).

793 *Macromphalina recticeps* (Pilsbry & Olsson, 1945). Extend distribution to the west coast of Baja Californa Sur off Puerto San Carlos, Bahía Magdalena, then north in the Gulf of California to off Bahía la Cholla, Sonora, Mexico. Depth: 2 to 16 m (S.).

796 *Macromphalina symmetrica* (Pilsbry & Olsson, 1945). Extend distribution north to Bahía la Cholla, Sonora (S.), and across the Gulf of California to off Puerto Escondido, Baja California Sur (K.), Mexico. Depth: intertidal zone to 52 m.

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COMMENTS ON "MARINE GASTROPOD HABITATS OF WESTERN PANAMA"

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In a recent article (The Festivus, 1994, vol. 26(10):107-112) Michael Small has given an excellent account of the various ecologic areas encountered on the western end of the Pacific coast of Panama. His descriptions of the habitats and their associated gastropod fauna is a valuable contribution. However, I must take issue with the identification of two of the muricid species that he cites as "RANGE EXTENSIONS" (p. 115, figs. 10, 12).

The *Haustellum lividum* (fig. 10) is not *lividum*, if anything it is *lividum tricorone* but I believe it is a new species (or subspecies, if one wishes). This is the form that I have discussed previously in a study of the Muricidae of the Pliocene Esmeraldas beds of northwestern Ecuador (1988, Tulane Stud. Geol. Paleont. 21(1):16). At that time, I noted:

> The eastern Pacific species *M. lividus*[1] is morphologically similar to the ancestral [*M. messorius* Sowerby] line, but lacks the labial rugae. The subspecies *M. lividus tricoronis* Berry, 1960, a more spinose form, also lacks the labial rugae. The latter two taxa are apparently confined to the Baja California and Gulf of California region; however, there are specimens from the Panama-Costa Rica area that are very similar to *M. lividus* or even *tricoronis*, in that they have spines, weakly excavated varices, and marked red spiral lines, but they retain the labial rugae. In fact, except for the red spiral lines, they are almost indistinguishable from the spinose forms of *M. messorius* that occur off Atlantic Panama.

In my opinion, these specimens with their labial rugae are sufficiently different from the northern *Haustellum lividum* and/or *H. lividum tricorone* to be given a name of their own. Whether one makes them a full species, or a subspecies of *H. messorium*, or of *H. lividum*, is a matter of personal choice. Inasmuch as they are sympatric with *H. recurvirostre*, they should not be considered a subspecies of the latter!

The specimen of *Aspella hastula* is probably correctly identified and is indeed a range extension, but the *"Aspella myrakeenae"* (fig. 12) is not that genus nor species. I believe it is an immature example of *Dermomurex (Trialatella) cunninghamae*, which is moderately common in the Panama area. This species does not reduce the varices to three until about the fifth whorl and the illustrated specimen is one that had not quite made the change. I have one specimen that matches the figured example exactly and, like the figured specimen, it also has stronger spiral ornamentation than is usual for *D. cunninghamae*. So, it is possible that it is a new species. But, on the basis of what we have now, I would simply call it *cunninghamae*.

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[1] In 1988 I was still using *Haustellum* as a subgenus of *Murex*. Since then *Haustellum* has been raised to generic level, necessitating the change of the formerly masculine species terminations to neuter to agree with *Haustellum* (for further discussion, see Vokes, 1993, Amer. Conch. 21(4):12). More recently Petuch (1994, Atlas of Florida Fossil Shells, p. 273) has described a new genus, *Vokesimurex*, with the type species *Murex messorius*. If one accepts this new genus, then the species names will revert to the masculine termination; however, if (as I prefer) the taxon is better placed as a subgenus of *Haustellum*, then the terminations will continue to be neuter. Thus: *Haustellum (Vokesimurex) messorium*, *lividum*, etc., but *tricorone* and *recurvirostre*, which are not nouns as I suggested in 1993, but are adjectives with two terminations (by analogy with *cornis (M)*, *cornis (F)*, *corne (N)* = horned).

TURCICA CAFFEA (GABB, 1865) - A NEW SIZE RECORD

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On August 23, 1994, Chuck Reitz and I made a dive off of Santa Barbara, California in an attempt to find Canbys Reef. When we hit bottom at about 25 meters, it was obvious that we'd missed our mark. Flat sand stretched as far as we could see in every direction. I'd learned from similar situations in the past that sometimes it's best just to finish out such a dive rather than going up, moving the boat, and trying again somewhere else. So that's what we did.

The only shell I found on the entire dive was a single crabbed specimen of *Turcica caffea* (Gabb, 1865) shown in Figure 1. This is a fairly common species in the waters off Southern California, but this particular specimen was so big, I didn't recognize it at first, in spite of its excellent condition.

When I returned home, I confirmed the identification using **Marine Shells of Southern California** by James H. McLean. I also checked the size records listed by Bert Draper in the **Lost Operculum Club's List of Champions** and by Wagner & Abbott in the **Standard Catalog of Shells, World Size Records.** Both sources listed a specimen collected in 1975 by Jim Cordy as having a length of 32.7 mm. **The List of Champions** also gives a diameter of 26.4 mm. The specimen I collected at Santa Barbara mearsues 39.1 mm in length and 29.8 mm in diameter at the base. That would make it a new world record by more than 6 millimeters!

While this specimen is uniformly dark gray, it is more commonly found in a banded form such as the specimen figured in an article in the October 1990 issue of **The Festivus**.

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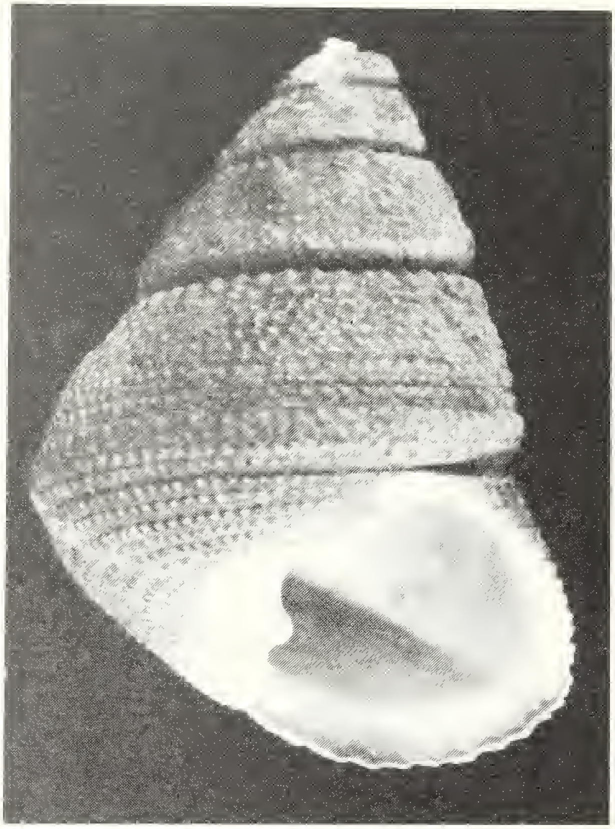

Figure 1. *Turcica caffea* (Gabb, 1865). Length: 39.1 mm, diameter: 29.8 mm. Photo: D. K. Mulliner.

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THE FESTIVUS

A publication of the San Diego Shell Club

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Room 104, Casa Del Prado, Balboa Park

PROGRAM

Collecting in Tanzania and Zanzibar

Club member and frequent tour director Don Pisor will give a slide presentation on his recent trips to Tanzania and Zanzibar. He will also have a display of shells of the area.

Mini-auction of books

Shells of the month: African shells
Meeting date: March 16, 1995

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CLUB NEWS

Because this issue had to go to press early, the minutes of the February meeting will appear in the April issue. [Ed.]

The Annual Auction/Potluck

On Saturday evening April 22nd the annual auction/ potluck will be held at the Clubhouse of Wes Farmer's condo. (Additional details and map will appear in the April issue.) The festivities will begin at 6:00 p.m. with the usual attitude adjustment hour featuring "Dave's punch." The potluck dinner will begin at 7:00 p.m. and the auction will start promptly at 8:00 p.m.

This is the Club's biggest event of the year both socially and financially. Members and guests look forward to it and it is always great fun. But it is only so because members are generous and donate fine shells. Your quality specimens with collecting data, where possible, and shell related items are much needed to make this auction a success.

Please bring your donation to the next meeting or contact a board member to arrange for its pickup.

A signup sheet for the potluck contributions will be available at the March meeting and the telephone committee will contact members as well.

Pacific Shell Club Announces Their Second Annual Shell Show

The Pacific Shell Club will hold their second annual shell show on May 7th. If you plan on attending, mark your calendars. If you plan on entering the show, contact Frank Jewett, Shell Show Chairman.

Three Annual Meetings Announced

The 61st annual meeting of **The American Malacological Union (AMU)** will be held in Hilo, Hawaii from June 8-12, 1995. It will be held at the University of Hawaii at Hilo and "the meeting is a celebration of islands." Three symposia are scheduled: biogeography convened by Gustav Paulay, cephalopods convened by Richard Young and conservation convened by Elaine Hoagland.

Accommodations will be in University of Hawaii dormitories on campus with a meal plan. Special events include the President's Welcome, a sunset reception at Lyman House Museum, a barbecue and final banquet. Field trips include tidepools, snorkeling, lava tubes, rainforest, the volcano and kipukas (oases with snails on Mauna Kea). Contact President E. Alison Kay (808) 956-8620 [phone] or (808) 956-8612 [FAX] for further information.

The 23rd annual **Conchologists of America (COA)** convention will be held at the Pan Pacific Hotel in downtown San Diego just minutes from the waterfront. The San Diego Shell Club will again host the convention which will be from June 23-28 with field trips on the 29th.

Many exciting events are planned. In addition to the fine talks, auction, drawings and bourse, there will be a welcome party, dinner cruise, field trips to a fossil bed, to Rosarito Beach, Mexico, and the new Stephen Birch Aquarium in La Jolla. Contact Chairman Don Pisor (619) 279-93204 [phone] or (619) 234-0250 [FAX] for further information.

Don't miss this exciting event in San Diego.

The **Western Society of Malacologists** will hold its 28th annual meeting at the Resort at Chena Hot Springs near Fairbanks, Alaska from June 2-6, 1995. The agenda will include contributed papers on all areas of molluscan studies. Symposia on ecology and paleoecology will also be scheduled. Additionally, the University of Alaska Museum Aquatic Collection will be available for examination prior to the meeting. Contact President Nora R. Foster (907) 474-9557 [phone] or FYAQUA@AURORA.ALASKA.EDU [E-mail] for further details.

New Edition of The Directory of Conchologists/Malacologists

Of Sea and Shore Publications announces the upcoming 2nd edition of **The Directory of Conchologists/Malacologists** listing nearly 1500 collectors and professionals from around the world with addresses and interests, etc. Write to editor Tom Rice, P..O. Box 219, Port Gamble, WA 98364 USA.

INFAUNAL BIVALVES OF THE GULF OF THAILAND

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INTRODUCTION

Recently I have had an opportunity to delve into the murky world of bivalve taxonomy in the Indo-Pacific region. My first experience should have sent me running back to California, but instead it piqued my interest to a point of insatiable curiosity. My good friend, Brian Morton, invited me to work on the small commensal bivalves of Hong Kong. The project seemed innocent enough, and we allowed a month to collect material and write up the descriptions.

Then the trouble began. The literature on this group was so widely scattered, it took almost a full month before we could place names on half of the species. A visit to the National Science Museum in Tokyo further added to the confusion, as examining the types struck down many of the species we had definitively identified. After a year of studying type specimens at the Smithsonian Institution, Museum of Comparative Zoology, Academy of Natural Sciences, Philadelphia, and The Natural History Museum, London, we had delimited 26 species, six of which were new to science (Morton & Scott, 1989).

Similarly during a recent workshop in Hong Kong, I found myself dizzy with a large collection of offshore bivalves and no place to turn for assistance. Since then two excellent books have appeared, on the larger bivalve species in the Red Sea (Oliver, 1992) and Australia (Lamprell & Whitehead, 1992), that greatly expand our knowledge of Indo-Pacific bivalves. I have attempted to further elucidate the Indo-West Pacific fauna in a recent publication on Hong Kong bivalves (Scott, 1994b).

When the opportunity arose to identify the bivalves for an environmental study in the Gulf of Thailand, I jumped at the chance. I was not disappointed as the Thai clams proved to be even more challenging than those of Hong Kong. Bivalve literature on the region was sparse; Lynge (1909) published the last major work in the Gulf, while Nielsen (1986) provided a very detailed account on the coral associated bivalves near Phuket. Rather than let my work on this project languish in an environmental report, my thought was to present the findings to the readers of **The Festivus**. My sincere hope is that this publication will generate more interest (and counterpoint views) in the Indo-Pacific Bivalvia.

The following is a first step at describing the small infaunal bivalves in the Gulf of Thailand. While I have examined much of the Indo-Pacific type material at several museums, identification of many of the Thailand species was problematic. I have chosen to align them with described species, as new descriptions are outside the scope of this publication. Provided for each species are key references, a diagnosis, general distributional information, and comparisons with morphologically similar species.

MATERIALS AND METHODS

Benthic samples were taken in August 1990 in the central Gulf of Thailand (Figure 1) between 09°40′N and 08°50′N, and from 101°15′E to 40′E. Depths sampled ranged from 60-70 meters. Bottom temperatures varied only slightly, from 26.5 - 28.5°C. Bottom sediments were quite variable ranging from silty sand to clayey silt, with up to 3% gravel found at a few stations.

Bivalve specimens were collected by a small infaunal grab sampler (0.04 m^2 Young-modified van Veen grab). Sediments were washed in running sea water over a 0.5 mm screen. Washed samples were preserved in 10% formalin for several days and then transferred to 70% ethyl alcohol. Specimens were extracted from the sediments under a dissecting microscope and identified to the lowest taxonomic unit.

Voucher specimens for this study are housed at the Santa Barbara Museum of Natural History, California, USA and Chulalongkorn University, Bangkok, Thailand.

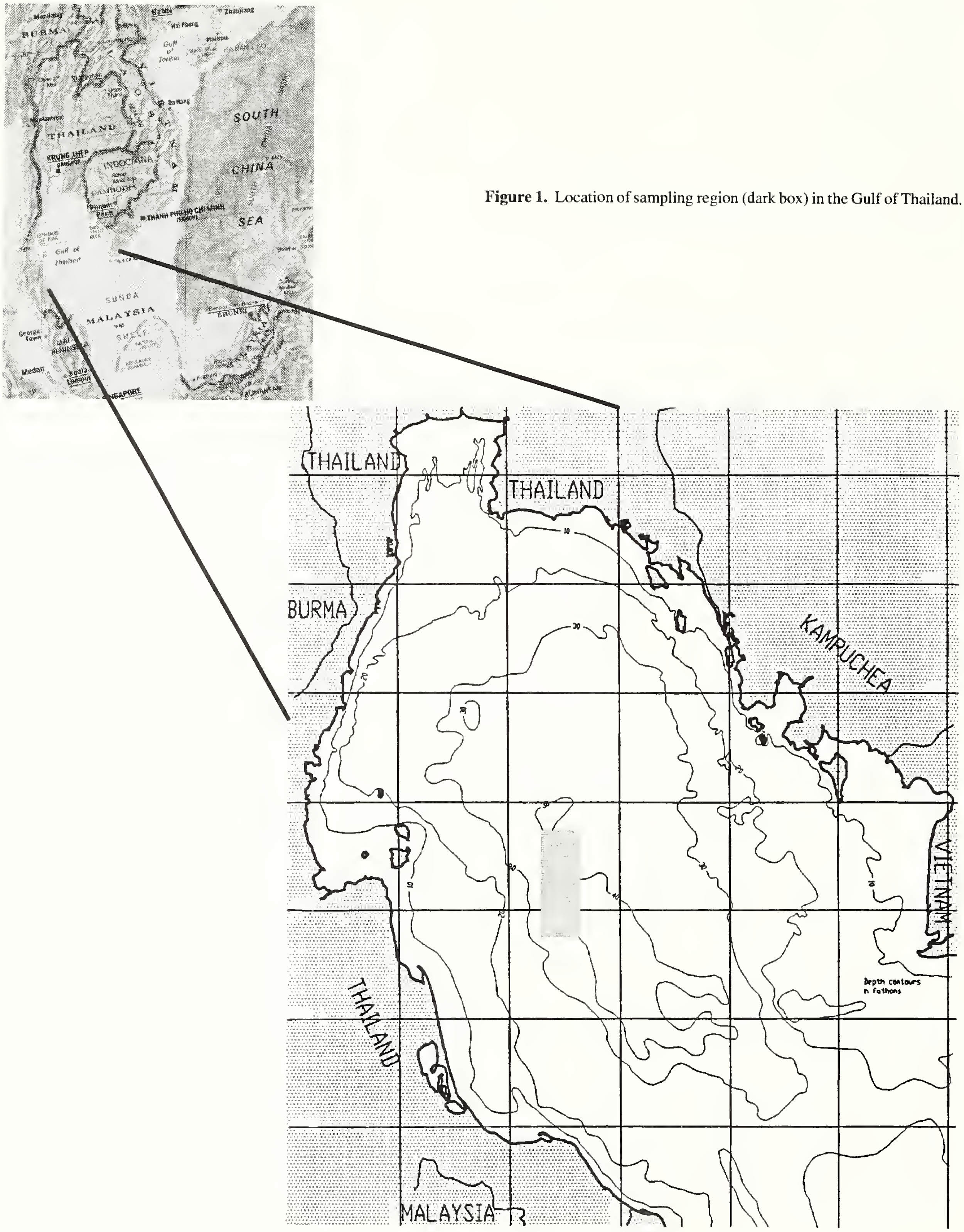


Figure 1. Location of sampling region (dark box) in the Gulf of Thailand.

ACKNOWLEDGMENTS

Deep thanks are due to principal investigator, Dr. Roy Kropp, Battelle Ocean Sciences, Duxbury, Massachusetts, who invited me to participate in this project, provided habitat data, and encouraged me to publish the findings. The study was funded by UNOCAL Thailand, Ltd. and I applaud their efforts to better understand the marine fauna in the region.

Lynne Gwinn provided encouragement throughout the project, and prodded me to complete this manuscript. Special thanks to John Taylor (The Natural History Museum, London), Akihiko Matsukuma (National Science Museum, Tokyo), Alan Kabat (Smithsonian Institution, U.S. National Museum of Natural History), Gary Rosenberg (Academy of Natural Sciences, Philadelphia) and Kenneth Boss (Museum of Comparative Zoology) for providing access to their collections and extended loans of specimens.

Eugene V. Coan provided useful comments on the manuscript and loaned me pertinent literature.

CHECKLIST OF GULF OF THAILAND BIVALVE MOLLUSKS

PALAEOTAXODONTA

- Nuculidae
  - *Ennucula cyrenoides* (Kuroda, 1929)
  - *Ennucula* cf. *layardi* (A. Adams, 1856)
  - *Ennucula niponica* (Smith, 1885)
  - *Nucula tokyoensis* (Yokoyama, 1920)
- Yoldiidae
  - *Yoldia cf. serotina* (Hinds, 1843)
  - *Portlandia japonica* (Adams & Reeve, 1850)

PTERIOMORPHIA

- Arcidae
  - *Diluvarca* cf. *ferruginea* (Reeve, 1844)
  - *Anadara mortenseni* (Lynge, 1909)
  - *Acar plicata* (Dillwyn, 1817)
- Mytilidae
  - *Amygdalum soyae* Habe, 1958
  - *Adula crypta* Dall, Bartsch & Rehder, 1938
- Pinnidae
  - *Pinna* sp. juvenile
- Pectinidae
  - *Serratovolva tricarinata* (Anton, 1839)
- Limidae
  - *Limaria* cf. *fragilis* (Gmelin, 1791)

HETERODONTA

- Lucinidae
  - *Anodontia edentula* (Linnaeus, 1758)
  - *Codakia pulchella* (Lynge, 1909)
  - "*Cavatidens*" *imajimai* (Habe, 1981)
  - *Lucina dentifera* Jonas, 1846
- Montacutidae
  - *Curvemysella paula* (A. Adams, 1856)
  - *Mysella lilium* (Lynge, 1909)
- Galeommatidae
  - *Scintilla* sp. juvenile
- Tellinidae
  - *Tellina valtonis* Hanley, 1844
- Psammobiidae
  - *Gari anomala* (Deshayes, 1855)
- Solecurtidae
  - *Azorinus abbreviatus* (Gould, 1861)
- Solenidae
  - *Solen ceylonensis* (Leach, 1814)
- Cutellidae
  - *Ensiculus* cf. *cultellus* (Linnaeus, 1758)
  - *Phaxus attenuatus* (Dunker, 1862)
- Veneridae
  - *Timoclea* cf. *farsiana* Biggs, 1973
  - *Timoclea scabra* (Hanley, 1844)
  - *Dorisca* cf. *nana* (Melvill, 1898)
- Corbulidae
  - *Anisocorbula* cf. *venusta* (Gould, 1861)
  - *Varicorbula rotalis* (Hinds, 1843)
  - *Solidicorbula erythrodon* (Lamarck, 1818)
- Gastrochaenidae
  - *Gastrochaena* cf. *dentifera* Dufo, 1840
- Hiatellidae
  - *Saxicavella* sp. A

ANOMALODESMATA

- Lyonsiidae
  - *Lyonsia* sp. A
- Pandoridae
  - *Pandora* sp. A

Thraciidae
Eximiothracia cf. *concinna* (Gould, 1861)

Verticordiidae
Verticordiidae sp. A

Cuspidaridae
Cardiomya singaporensis (Hinds, 1843)
Plecotodon cf. *ligula* (Yokoyama, 1922)
Austroneaera cf. *semipellucida* (Kuroda, 1948)

SPECIES ACCOUNT

Ennucula cyrenoides Kuroda, 1929

Literature

Xu, 1984; Habe, 1977; Kira 1965 (pl. 48, fig. 6)

Diagnostic Characters

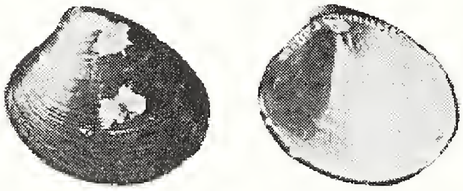
1. Outer surface with heavy, closely spaced, commarginal ribs (usually absent from beaks).
2. Shell ovate to elongate, inflated; posterior margin produced in some specimens.
3. Furrow not present along dorsal margin.

Distribution

Indo-Pacific, Japan to Thailand.

Similar Species

The heavy, closely spaced commarginal ribs separate *Nucula cyrenoides* from all other Indo-Pacific species.



Nucula cyrenoides Kuroda, 1929
Holotype (original figure)

Ennucula cf. *layardi* (A. Adams, 1856)

Literature

Lynge, 1909

Diagnostic Characters

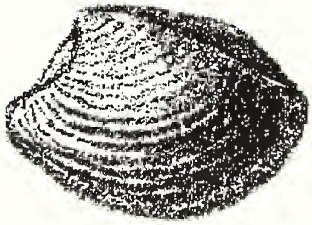
1. Shell inflated, subequilateral; anterior end slightly longer.
2. Shell surface smooth, or with minute commarginal growth striae.
3. Posterior margin produced.

Distribution

Gulf of Thailand

Similar Species

Ennucula tenuis (Montagu, 1808) - shell marked inequilateral with anterior much longer; posterior margin not produced.



Ennucula layardi (A. Adams, 1856)
Figure 36 from Reeve, 1873

Ennucula niponica (Smith, 1885)

Literature

Smith, 1885 (pl. 18, figs. 8-8a); Habe, 1977 (pl. 4, figs. 15, 16); Kira, 1965

Diagnostic Characters

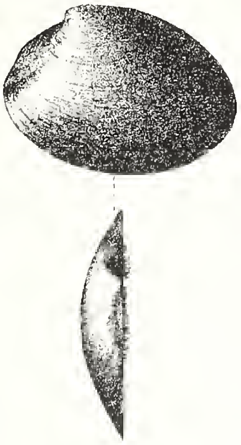
1. Outer shell surface smooth, or with only minute concentric growth striae.
2. Shell elongate, posterior margin produced, broadly pointed, beaks opisthogyrate (pointing towards posterior).
3. Deep furrow present along the antero-dorsal margin in larger specimens.
4. Shell large for genus, up to 22 mm in length (most other species less than 10 mm).

Distribution

Throughout the Indo-Pacific region; 50-1450 m.

Similar Species

Ennucula tenuis (Montagu, 1808) - shell ovate, not elongate; no furrow on antero-dorsal margin; posterior margin usually very truncate.



Ennucula niponica (Smith, 1885)
original figure in Smith

Nucula tokyoensis Yokoyama, 1920

Literature

Xu, 1984; Oyama, 1980 (pl. 20, figs. 28-29); Habe, 1977 (pl. 2, fig. 3)

Diagnostic Characters

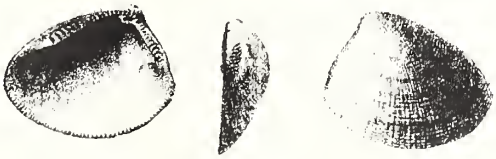
1. Outer surface with weak radial striae (may be crossed by weak concentric striae in larger specimens).
2. Shell ovate, inequilateral, posterior truncate.

Distribution

Japan; now Gulf of Thailand

Similar Species

The fine radial ribs differentiate *N. tokyoensis* from all others in the region.



Nucula tokyoensis Yokoyama, 1920
Lectotype figured in Oyama, 1980

Yoldia cf. serotina (Hinds, 1843)

Literature

Reeve, 1871 (vol. 18, sp. 5); Lynge, 1909

Diagnostic Characters

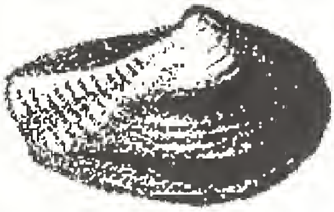
1. Shell elongate, compressed laterally; inequilateral, posterior end longer.
2. Antero-dorsal margin with thin keel, demarcated by a furrow.
3. Posterior margin obliquely truncate.
4. Antero-ventral margin widely gaping.
5. Sculpture with faint oblique lines on outer surface of shell.

Distribution

Indo-Pacific; Singapore, Philippines, Borneo, Gulf of Oman, Thailand

Similar Species

Yoldia thraciaeformis (Storer, 1838) - shell subquadrate; posterior margin more broadly truncate; antero-dorsal margin not keeled.



Yoldia serotina (Hinds, 1843)
Figure 5 from Reeve, 1871

"Portlandia" japonica (Adams & Reeve, 1850)

Literature

Xu, 1984; Habe, 1977 (pl. 3, fig. 16); Kira, 1965 (pl. 42, fig. 11); Reeve, 1871 (vol. 18, sp. 20)

Diagnostic Characters

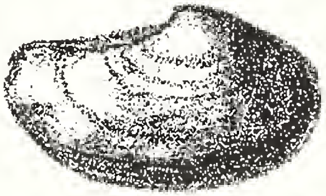
1. Shell smooth externally, ovate, inflated laterally; subequilateral.
2. Anterodorsal margin with slight depression (escutcheon); without keel or furrow.
3. Posterodorsal margin pointed, changing to broadly rounded ventrally.
4. Entire ventral margin tightly closed, not gaping.

Distribution

Indo-Pacific; Japan, Gulf of Thailand

Similar Species

The inflated, subequilateral shell separates *Portlandia japonica* from all related species in the region.



Portlandia japonica (Adams & Reeve, 1850)
Figure 20 in Reeve, 1871

Diluvarca ferruginea (Reeve, 1844)

Literature

Reeve, 1844 (vol. 2, pl. 6, sp. 39); Li, 1983b (pl. 2, fig. 2); Habe, 1977 (pl. 8, fig. 1)

Diagnostic Characters

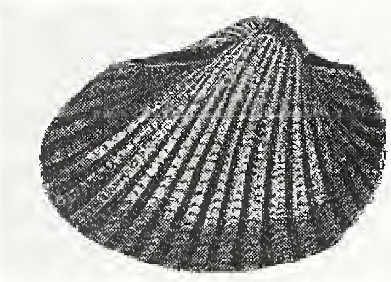
1. Shell equivalve; beaks broad, prominent.
2. Dorsal margin straight; posterior and anterior margins evenly rounded.
3. Approximately 24 broad, flat-topped radial ribs; interspaces nearly as broad as ribs.
4. Periostracal hairs fine, long, pointed; aligned in single row.

Distribution

Indo-Pacific; Japan, Hong Kong, Gulf of Thailand

Similar Species

Anadara claticula (Nyst, 1848) - lacks single row of periostracal hairs; posterior margin obliquely truncate, not rounded.



Diluvarca ferruginea (Reeve, 1844)
Original Reeve illustration, figure 39

Anadara mortenseni (Lynge, 1909)

Literature

Lynge, 1909 (pl. 2, figs. 1-2)

Diagnostic Characters

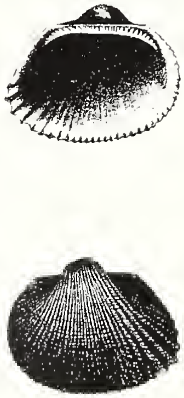
1. Shell quadrate, subequilateral, small (less than 15 mm)
2. Radial ribs numerous (up to 47 ribs) crossed by concentric striae giving a nodose appearance.
3. Periostracal hairs short and triangular, broad at base, sharply pointed at tip; aligned in a single row in rib interspaces.

Distribution

Gulf of Thailand

Similar Species

Striarca tenebrica (Reeve, 1844) - overall shape close to *Anadara mortenseni*, but has very dense, fine, straight periostracal hairs that are arranged in many rows in interspaces and on radial ribs.



Anadara mortenseni (Lynge, 1909)
Original illustration

Acar plicata (Dillwyn, 1817)

Literature

Scott, 1994b (pl. 1C); Oliver, 1992 (pl. 1, figs. 5a-b); Li, 1983a (pl. 1, fig. 1); Li, 1984 (pl. 2, fig. 13); Habe, 1977 (pl. 5, figs. 13, 14); Kira, 1965 (pl. 43, fig. 6)

Diagnostic Characters

1. Shell subquadrate; markedly inequilateral, posterior much longer.

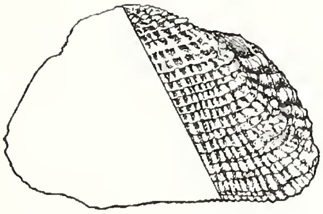
2. Heavy concentric ribs, crossed by radial ribs, give a beaded appearance.
3. Periostracal hairs absent.
4. Teeth heavy, not numerous; with only 3-4 teeth present anteriorly.

Distribution

Indo-Pacific; Japan, Hong Kong, Red Sea.

Similar Species

There are no morphologically similar species in the region.



Acar plicata (Dillwyn, 1817)
Illustration from Oliver, 1992

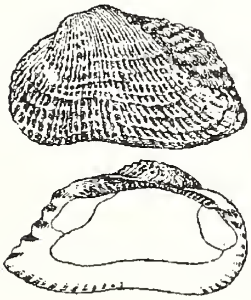


Illustration from Habe, 1977

Amygdalum soyae Habe, 1958

Literature

Okutani, Tagawa & Horikawa, 1988 (p. 50); Habe, 1981 (pl. 4, fig. 3)

Diagnostic Characters

1. Shell smooth, very thin, transparent; with white blotches posteriorly.
2. Beaks almost at anterior end; not prominent.
3. Posterior margin flaring.
4. Periostracum clear to pale yellow.

Distribution

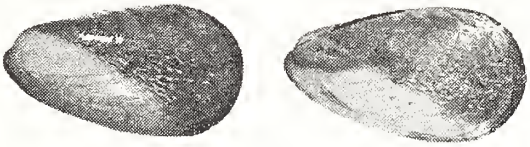
Indo-Pacific; Japan, Gulf of Thailand

Similar Species

Amygdalum peasei (Newcomb, 1870) - posterior end not broadly flaring; posterior blotches brown, not white.

Amygdalum watsoni (Smith, 1885) - shape similar but periostracum dark brown.

Amygdalum dendriticum Megerle von Mühlfeldt, 1811 - Oliver (1992) found little difference between this Caribbean species and those in the Indo-Pacific. Further global study is necessary to elucidate the differences between all species in this uncommon genus.



Amygdalum soyae Habe, 1958
Photograph from Okutani, *et al.*, 1988

Adula crypta Dall, Bartsch & Rehder, 1938

Literature

Habe, 1981 (pl. 1, fig. 1)

Diagnostic Characters

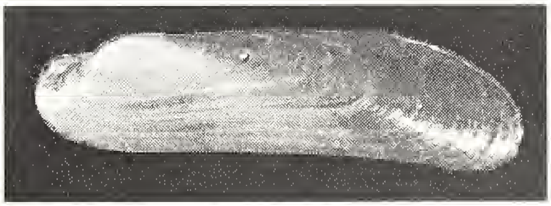
1. Shell elongate, cylindrical; light to dark brown in color.
2. External sculpture only of fine commarginal growth striae and weak radial striae.
3. Posterodorsal margin straight, tapering posteriorly.

Distribution

Indo-Pacific; Japan, Hawaii, now Gulf of Thailand.

Similar Species

Adula schmidti (Schrenck, 1867) - posterodorsal margin flaring with keel; posterior margin straight to slightly rounded, not tapered.



Adula crypta Dall, Bartsch & Rehder, 1938
Photograph from Habe, 1981

Pinna sp. juvenile

Literature

Lynge, 1909 (pl. 2, figs. 19-20)

Diagnostic Characters

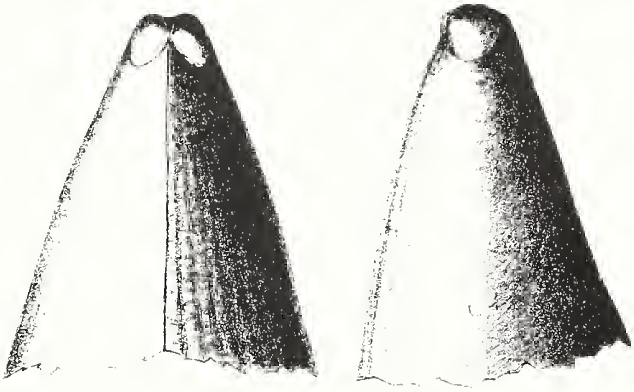
1. Embryonic shell smooth, triangular; with distinct separation from "adult" shell.
2. Shell extremely thin, transparent; with radial serrations on "adult" shell.

Distribution

Indo-Pacific

Similar Species

Lynge (1909) listed five species of *Pinna* in the Thailand waters. Unfortunately all specimens collected in this study were too small to identify to species.



Pinna sp. juvenile
Illustrations from Lynge, 1909

Serratovola tricarinata (Anton, 1839)

Literature

Okutani, Tagawa & Horikawa, 1988 (p. 70); Habe, 1977 (pl. 16, fig. 12); Matsukuma, Okutani & Habe, 1991 (pl. 135, fig. 10); Kira, 1965 (pl. 49, fig. 5)

Diagnostic Characters

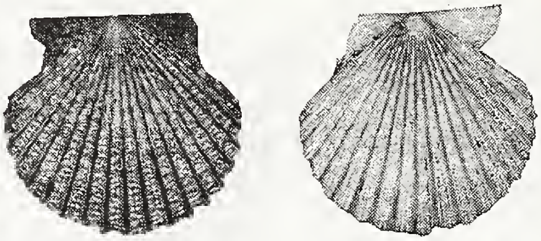
1. Left valve flat, speckled with orange-red spots and commarginal lines; right valve slightly convex, primarily white with very faint reddish spots and commarginal lines.
2. Radial ribs 17-19 in number, broad with central carina, interspaces wide.
3. On all central radial ribs, scaly, low serrations are found on either side of the carina.

Distribution

Indo-Pacific; Japan, Taiwan, now Gulf of Thailand

Similar Species

Serratovola aspera (Sowerby, 1842) - has a larger umbonal angle and flatter, broader interspaces (Okutani, *et al.*, 1988). It is possible that this species is only a geographic variation of *S. tricarinata.*



Serratovola tricarinata (Anton, 1839)
Illustration from Okutani, *et al.*, 1988

Limaria fragilis (Gmelin, 1791)

Literature

Oliver, 1992 (pl. 14, figs. 7a-b); Lamprell & Whitehead, 1992 (fig. 96); Kira, 1965 (pl. 53, fig. 3); Lynge, 1909.

Diagnostic Characters

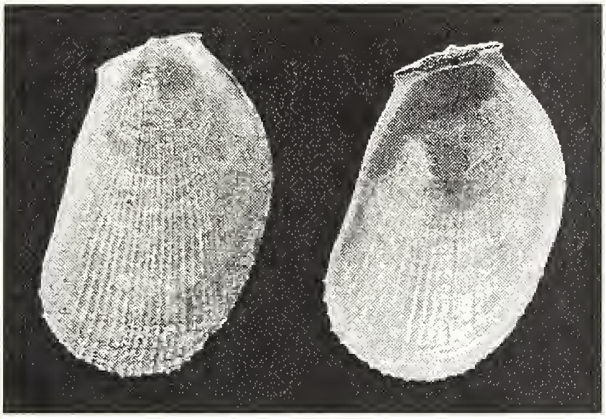
1. Juvenile outer shell nearly smooth, with only a few low radial ribs; adult shell with up to 30 fine radial ribs.
2. Dorsal and ventral margins straight, nearly parallel.
3. Anterior ear very short; anteroventral margin broadly rounded.
4. Shell extremely thin, transparent.

Distribution

Indo-Pacific; Japan, Singapore, Red Sea, Gulf of Thailand

Similar Species

Limaria orientalis (Adams & Reeve, 1850) - Outer shell thicker, with numerous, distinct sharp radial ribs; dorsal margin rounded. This species was found as a dead shell in the Gulf of Thailand study.



Limaria fragilis (Gmelin, 1791)
Photograph from Oliver, 1992

Anodontia edentula (Linnaeus, 1758)

Literature

Oliver, 1992 (pl. 20, figs. 8a-b; p. 95, figs. 18a-b); Lamprell & Whitehead, 1992 (fig. 138); Abbott, 1991 (pl. 48, fig. 8); Philippi, 1847 (figs. 1, 3); Habe, 1977 (pl. 23, figs. 11-12); Kira 1965 (pl. 54, fig. 6).

Diagnostic Characters

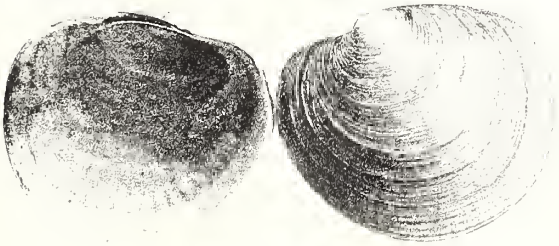
1. Outer shell with very reduced sculpture; weak commarginal or radial striae may be present.
2. Adult shell without cardinal teeth, juveniles may have posterior tubercle.
3. Anterior margin broadly rounded to straight.
4. Inequilateral, posterior end much longer.
5. Shell inflated, globose.

Distribution

Indo-Pacific; Japan, Red Sea, Gulf of Thailand

Similar Species

The shell shape and sculpture of this species is extremely variable. Oliver (1992) lists five synonyms and numerous misidentifications based on shape and sculpture. The entire genus *Anodontia* is in need of a monographic revision.



Anodontia edentula (Linnaeus, 1758)
Illustration from Philippi, 1847

"Cavatidens" imajimai (Habe, 1981)

Literature

Habe, 1981 (pl. 2, fig. 4)

Diagnostic Characters

1. Shell inflated, subquadrate; outer sculpture smooth except for fine commarginal striae.
2. Deep depression (lunule) just anterior of beaks.
3. Posterodorsal region with shallow depression (sulcus); forming an indentation on the posterior margin.
4. Cardinal teeth small but well developed in juveniles, obscure to absent in adults.
5. Ligament internal; in a long, deep pit (resilifer).

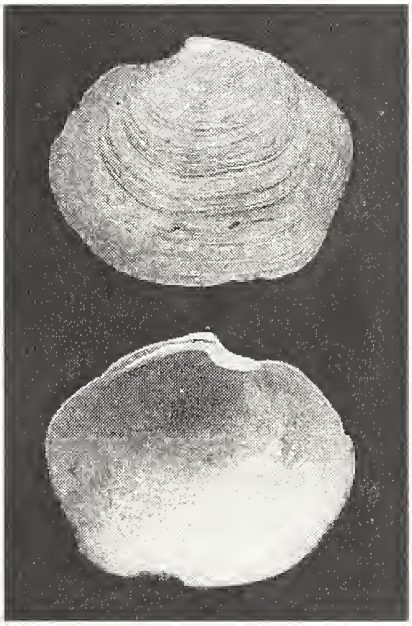
Distribution

Indo-Pacific; Japan, now Gulf of Thailand

Similar Species

Anodontia edentula (Linnaeus, 1758) - superficially resembles this species externally, but *A. edentula* does not have a deep lunule and is strongly inequilateral.

Habe (1981) placed this species in *Cavatidens* Iredale, 1930, but that genus has a very narrow hinge plate and is completely edentulous at all ages. The Thailand species is placed within *sensu lato* concept of this genus.



Cavatidens imajimai (Habe, 1981)
Holotype

Lucina dentifera Jonas, 1846

Literature

Oliver, 1992 (pl. 19 figs. 6a-b, p. 94, fig. 14)

Diagnostic Characters

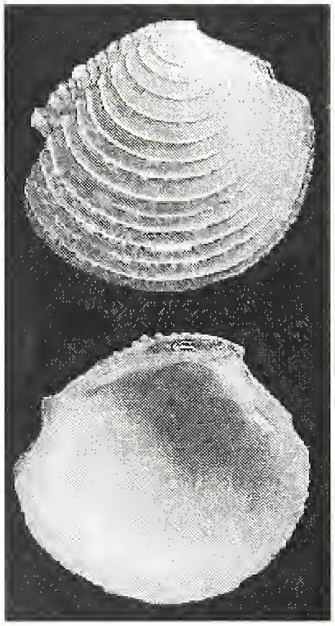
1. Shell orbicular, subequilateral.
2. With heavy, widely-spaced commarginal ribs; turning into fragile lamellose spines along the dorsal margin.
3. Posteroventral margin with deep sulcus (elongate depression).

Distribution

Indo-Pacific; Red Sea, Gulf of Thailand.

Similar Species

The fragile lamellose spines and strong commarginal ribs easily separate this species from all other lucinids in the region.



Lucina dentifera Jonas, 1846
Illustration from Oliver, 1992

Curvemysella paula (A. Adams, 1856)

Literature

Morton & Scott, 1989 (p. 146, fig. 17); Habe, 1977 (pl. 27, figs. 10-11)

Diagnostic Characters

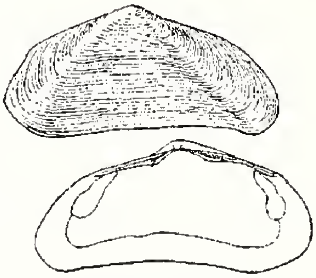
1. Shell elongate; ventral margin incurved.
2. Right valve with long lateral teeth; left valve edentulous.
3. Resilifer small, triangular; directly below beaks.

Distribution

Indo-Pacific; Australia, Japan, Hong Kong, Gulf of Thailand

Similar Species

All *Mysella* species have two teeth in the right valve and none in the left, however *C. paula* has very elongate teeth, as well as an incurved ventral margin.



Curvemysella paula (A. Adams, 1856)
Illustration from Habe, 1977

Mysella lilium (Lynge, 1909)

Literature

Lynge, 1909 (pl. 3, figs. 25-26)

Diagnostic Characters

1. Shell subquadrate, compressed; inequilateral, posterior end longer.
2. Two minute diverging cardinals in right valve, left valve edentulous.
3. Ligament in very small triangular resilifer.

Distribution

Gulf of Thailand

Similar Species

The relationship of all *Mysella* is in grave doubt, with the genus in need of a thorough worldwide revision. Currently species are differentiated by subtleties in shell shape and dentition. *M. lilium* is more compressed and has smaller teeth than any other species in the region.

Mysella matsuwanensis (Yamamoto & Habe, 1959) was collected as a dead shell in this Thailand study. *M. matsuwanensis* is relatively higher and more equilateral than *M. lilium.*

Mysella lilium (Lynge, 1909)
Original Lynge illustration

Scintilla sp. juvenile

Literature

Morton & Scott, 1989; Oliver, 1992

Diagnostic Characters

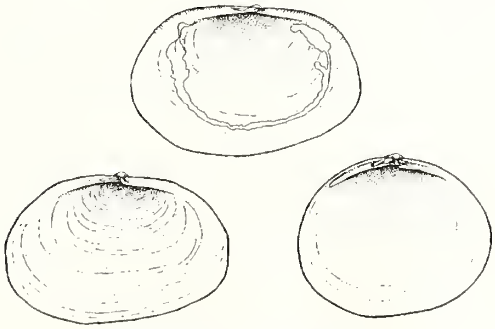
1. Shell thin, compressed, subequilateral.
2. Teeth very reduced, with two small teeth anterior of the beaks and one posterior.
3. Ligament in an oblique resilifer.

Distribution

Indo-Pacific

Similar Species

As with most small galeommatoideans, the *Scintilla* complex is poorly known. Deshayes (1856) described 37 species from the Indo-Pacific. Morton & Scott (1989) detailed three species from Hong Kong and provided several diagnostic characters for the group.



Unidentified *Scintilla* species
Illustrations from Oliver, 1992

Tellina valtonis Hanley, 1844

Literature

Oliver, 1992 (pl. 35, figs. 7a, b; p. 146, text figs. 69a, b); Lamprell & Whitehead, 1992 (fig. 308)

Diagnostic Characters

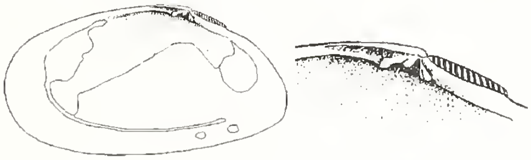
1. Shell elongate, ovate; markedly inequilateral, anterior much longer; color light pink to deep red; external of shell smooth, polished, or with feeble commarginal or radial striae.
2. Pallial sinus deep, nearly reaching anterior adductor scars; sinus equal in both valves.
3. Ligament short, protruding.
4. Anterior lateral tooth in right valve large, oblique; nearly fused with anterior cardinal tooth.

Distribution

Indian Ocean; Red Sea, now Gulf of Thailand

Similar Species

Tellina vestaloides Yokoyama, 1920, is subequilateral, with a weak anterior lateral in the right valve, an elongate ligament, and more prominent commarginal sculpture.



Tellina valtonis Hanley, 1844
Illustrations from Oliver, 1992

Gari anomala (Deshayes, 1855)

Literature

Willan, 1993 (figs. 7, 8, 76-81); Lamprell & Whitehead, 1992 (fig. 393); Okutani, *et al.,* 1988 (p. 135); Habe, 1964 (pl. 61, fig. 4)

Diagnostic Characters

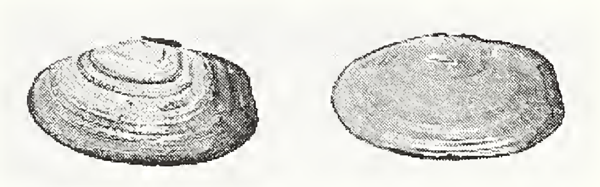
1. Shell subequilateral, thin, fragile; anterior sharply rounded, posterior obliquely truncate.
2. External shell sculpture of oblique ribs running from anterodorsal margin to the mid-dorsal margin; sculpture obscure to absent posteriorly.
3. Prodissoconch bulbous, protruding.

Distribution

Indo-Pacific; Japan, now Gulf of Thailand

Similar Species

Willan (1993) compares four morphologically similar species; *Gari anomala*, *G. lessoni* (Blainville, 1826), *G. pallida* (Deshayes, 1855), and *G. truncata* (Linnaeus, 1767).



Gari anomala (Deshayes, 1855)
Illustrations from Okutani, *et al.*, 1988

Azorinus abbreviatus (Gould, 1861)

Literature

Scott, 1994b (pl. 13C); Habe, 1977 (pl. 47, figs. 9, 10); Kira, 1965 (pl. 59, fig. 21)

Diagnostic Characters

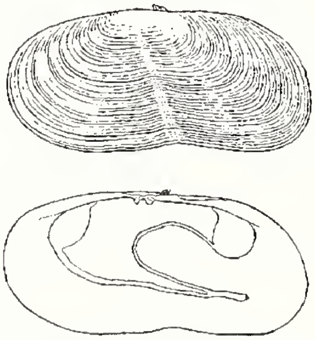
1. Shell subquadrate; subequilateral, posterior slightly longer; anterior and posterior margins broadly rounded; ventral margin with broad invagination.
2. Exterior of shell smooth, except for commarginal growth striae.

Distribution

Indo-Pacific; Japan, now Gulf of Thailand

Similar Species

Oliver (1992: p. 165) places the Red Sea specimens in *Azorinus coarctatus* (Gmelin, 1791), which appears to be more elongate and inequilateral than the Thailand specimens. The relationship between all Indo-Pacific *Azorinus* is in dire need of monographic attention.



Azorinus abbreviatus (Gould, 1861)
Illustration from Habe, 1977

Solen ceylonensis (Leach, 1814)

Literature

Oliver, 1992 (p. 135, text fig. 2; pl. 29, fig. 1)

Diagnostic Characters

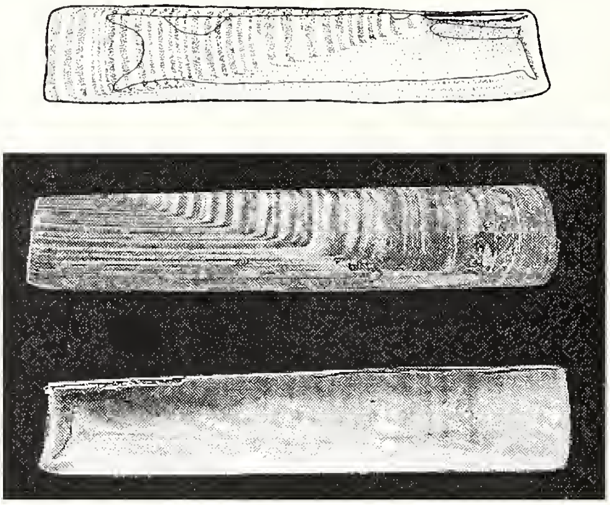
1. Shell elongate, cylindrical; beaks terminal.
2. Posterior margin straight, angled slightly inward; ventral margin straight.
3. Color white to transparent; may have red blotches or bands.

Distribution

Indian Ocean, Red Sea, now Gulf of Thailand.

Similar Species

Solen digitalis Jousseaume, 1891, has a rounded posterior end and slightly rounded ventral margin.



Solen ceylonensis (Leach, 1814)
Illustration and photograph from Oliver, 1992

Ensiculus cf. *cultellus* (Linnaeus, 1758)

Literature

Okutani, *et al.*, 1988 (p. 141 photo); Oliver, 1992 (p. 135, fig. 6; pl. 29, fig. 7a, b)

Diagnostic Characters

1. Shell elongate; dorsal and ventral margins curved.
2. Beaks subterminal, but distinctly posterior of the rounded anterior margin.

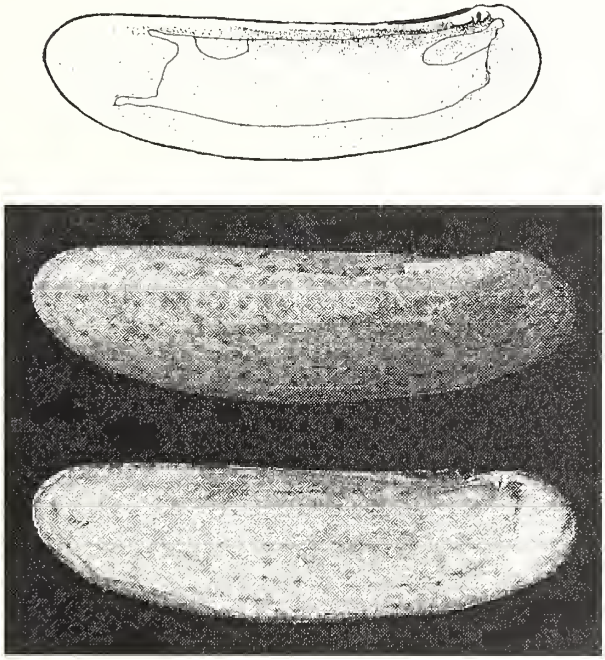
3. Shell very thin; light brown with reddish blotches
4. Posterior margin bluntly rounded, not tapered.

Distribution

Gulf of Thailand

Similar Species

The Gulf of Thailand specimens fit the description of *Ensiculus cultellus* except for the blunt posterior margin. Characteristically, *E. cultellus* has a rounded, tapered posterior margin. The Thailand species might represent a new species or an extreme variant of *E. cultellus.*



Ensiculus cultellus (Linnaeus, 1758)
Illustration and photograph from Oliver, 1992

Phaxas attenuata (Dunker, 1862)

Literature

Okutani, 1988 (p. 140, photo); Habe, 1977 (pl. 48, fig. 11)

Diagnostic Characters

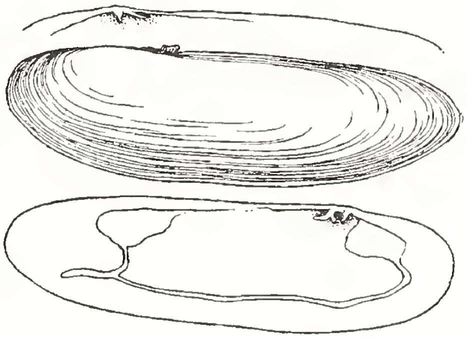
1. Shell elongate, elliptical; inequilateral, posterior much longer; beaks approximately one quarter of shell length from anterior margin.
2. Anterior and posterior margins broadly rounded.
3. Shell very thin, white; smooth except for very fine commarginal growth striae.

Distribution

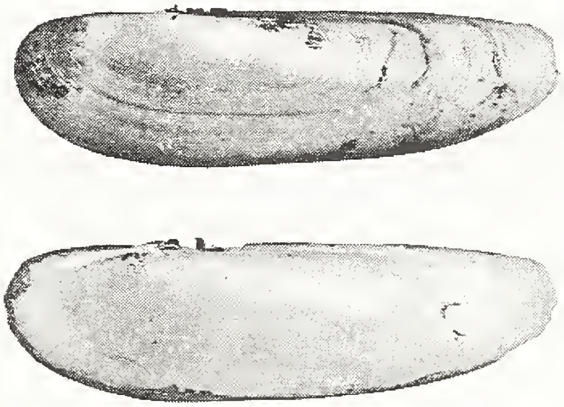
Indo-Pacific; Japan, now Gulf of Thailand

Similar Species

The distinctive shape and beak placement of this species allow clear separation from all other solenoids in the region.



Phaxas attenuata (Dunker, 1862)
Illustration from Habe, 1977



Photograph from Okutani, *et al.*, 1988

Timoclea cf. *farsiana* Biggs, 1973

Literature

Biggs, 1972 (pp. 398-401, text figs. 9 a-c)

Diagnostic Characters

1. Shell small (< 10 mm); subovate to trigonal; inequilateral, posterior end longer.

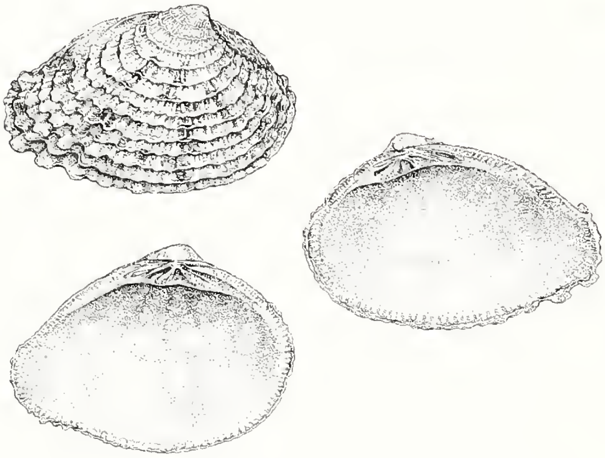
2. External sculpture of heavy radial ribs, overlain by lamellose commarginal ribs; radial ribs finest in central part of shell, heaviest on anterior third and posterocentral region; ribs lacking on extreme posterior in escutcheon region.
3. Internally all margins finely crenulate; approximately 24 fine radial ribs on the inner surface of the lunule.

Distribution

Persian Gulf; now Gulf of Thailand

Similar Species

Oliver (1992) outlines the differences of three other Indo-Pacific *Timoclea*; namely *T. costellifera* (Adams & Reeve, 1848), *T. roemeriana* (Issel, 1869), and *T. marica* (Linnaeus, 1758). These three species differ in nuances of the external sculpture and number of radial ribs in the lunular region.



Timoclea farsiana Biggs, 1973
Original illustrations in Biggs

Timoclea scabra (Hanley, 1844)

Literature

Scott, 1994b (pl. 11D); Lamprell & Whitehead, 1992 (fig. 477); Habe, 1964 (pl. 59, fig. 7)

Diagnostic Characters

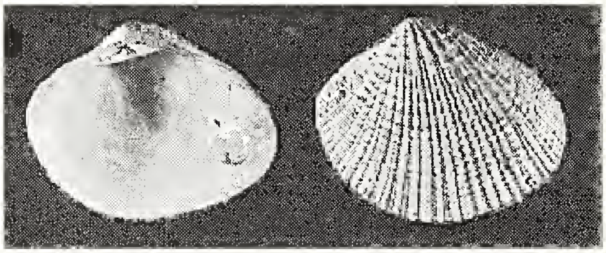
1. Shell subtrigonal; inequilateral, posterior much longer.
2. External sculpture of heavy, broad, widely-spaced radial ribs, crossed with commarginal lamellae.
3. Inner margin finely crenulate; inner shell with broad, shallow radial ribs.

Distribution

Indo-Pacific; China, Hong Kong, now Gulf of Thailand.

Similar Species

Timoclea micra (Pilsbry, 1904) is more ovate, and has closely spaced ribs. With further study *T. micra* may be determined to be a junior synonym of *T. scabra*.



Timoclea scabra (Hanley, 1844)
Photograph from Scott, 1994b

Dorisca nana (Melvill, 1898)

Literature

Habe, 1977 (pl. 53, figs. 8-9); Habe, 1964 (pl. 58, fig. 5)

Diagnostic Characters

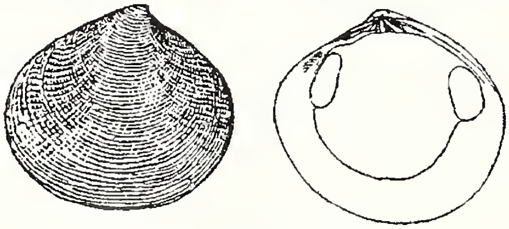
1. Shell subcircular to subovate; moderately compressed; solid; white to iridescent .
2. External sculpture in adults of radial divaricating ribs anteriorly and posteriorly, commarginal ribs centrally; juveniles smooth or with commarginal ribs only.
3. Juveniles with iridescent periostracum.
4. Hinge with large anterior lateral tooth.

Distribution

Indo-Pacific; India, Indonesia, Thailand, Japan.

Similar Species

This species is superficially similar to many other members of the Circinae, however its white color and iridescent periostracum (in juveniles only) easily separate *Dorisca nana* from all members of *Circe*.



Dorisca nana (Melvill, 1898)
Illustration from Habe, 1977

Anisocorbula cf. *venusta* (Gould, 1861)

Literature

Zhuang & Cai, 1983 (fig. 8); Habe, 1977 (pl. 59, fig. 9)

Diagnostic Characters

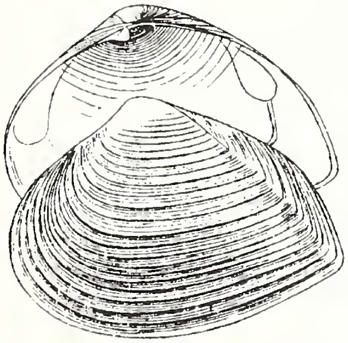
1. Shell subtrigonal; subequilateral, posterior slightly longer; beaks prominent.
2. External sculpture of commarginal ribs (not present on prodissoconch), overlain by fine radial ribs.
3. Posterior margin obliquely truncate.

Distribution

Indo-Pacific; Japan, Thailand

Similar Species

Like many other corbulid groups, the *Anisocorbula* is in serious need of revision. An exact determination could not be made with the juvenile specimens collected in this survey. *Anisocorbula lineata* (Lynge, 1909) is another possible name for this common Gulf of Thailand species.



Anisocorbula venusta (Gould, 1861)
Illustration from Zhuang & Cai, 1983

Varicorbula rotalis (Hinds, 1843)

Literature

Habe, 1977 (pl. 58, figs. 10-11)

Diagnostic Characters

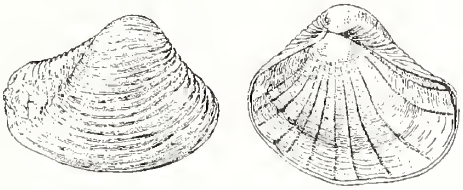
1. Shell subtrigonal; subequilateral; very inflated.
2. Right valve larger than left, smooth or with fine commarginal striae.
3. Left valve with distinct, fine, widely-spaced radial ribs.

Distribution

Indo-Pacific; Japan, now Gulf of Thailand

Similar Species

The radial ribs on the left easily separate this species from all relatives in the region.



Varicorbula rotalis (Hinds, 1843)
Illustration from Habe, 1977

Solidicorbula erythrodon (Lamarck, 1818)

Literature

Zhuang & Cai, 1983 (fig. 9); Habe, 1977 (pl. 59, figs. 10-12)

Diagnostic Characters

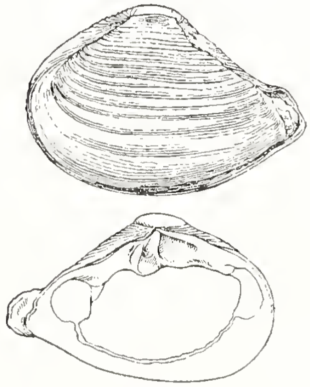
1. Shell subtrigonal; subequilateral; very inflated; very thick-shelled.
2. Posterior end constricted, attenuate, set off from rest of shell; forming a spout.
3. External sculpture of heavy commarginal ribs.

Distribution

Indo-Pacific; Japan, now Gulf of Thailand

Similar Species

The posterior "spout" of this species easily separates it from all other corbulids in the region.



Solidicorbula erythrodon (Lamarck, 1818)
Illustration from Habe, 1977

Gastrochaena cf. *dentifera* Dufo, 1840

Literature

Nielsen, 1986 (fig. 4F)

Diagnostic Characters

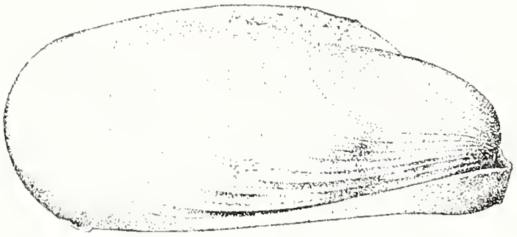
1. Shell elongate, elliptical; beaks terminal; broadly gaping ventrally.
2. Anteroventral margin flexed back into a wide callum.
3. Sculpture of fine commarginal ribs; oblique ribs not present.

Distribution

Indo-Pacific; Red Sea, Hong Kong, Thailand

Similar Species

Only a single damaged juvenile specimen of this species was present in this study making exact determination impossible. Nielsen (1986) compares nine species of coral-boring gastrochaenids from Phuket, Thailand. According to Nielsen (p. 15), the closest relative of *G. dentifera* in Thailand is *G. pexiphora* Sturany, 1899, that differs in subtleties of pedal muscle attachment and siphonal morphology.



Gastrochaena dentifera Dufo, 1840
Illustration from Nielsen, 1986

Saxicavella sp. A

Literature

Scott, 1994a

Diagnostic Characters

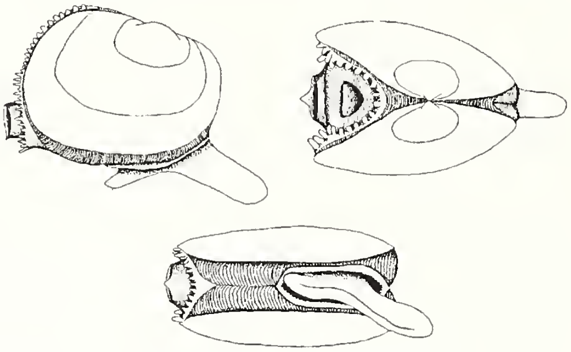
1. Shell less than 10 mm in length, rhomboid; widely gaping on all margins except at beaks.
2. Without siphons, with stout papillae fringing the siphonal region.
3. External sculpture of commarginal growth striae.

Distribution

Gulf of Thailand

Similar Species

Scott (1994a) details the differences between the three known species of *Saxicavella*. The single specimen from this study possibly represents a new species.



Saxicavella nybakkeni Scott, 1994
Illustration of holotype (species from northeastern Pacific Ocean)

Lyonsia sp. A

Literature

Habe, 1964 (pl. 64, figs. 1,2)

Diagnostic Characters

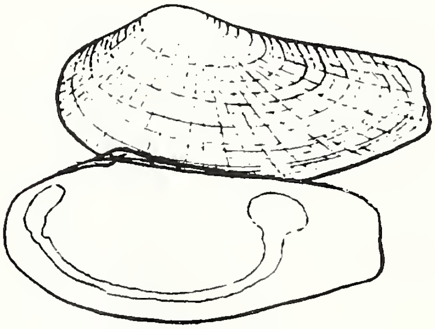
1. Shell subquadrate; inequilateral, posterior much longer; posterior truncate.
2. External sculpture of fine radial lines, with attached sand grains.

Distribution

Gulf of Thailand

Similar Species

The single damaged juvenile specimen collected in this study precludes a specific determination. Habe (1964) illustrates two common Indo-Pacific species.



Lyonsia sp.
Illustration from Keen & Coan, 1974

Pandora sp. A

Literature

Habe, 1977 (pl. 64, figs. 12-16)

Diagnostic Characters

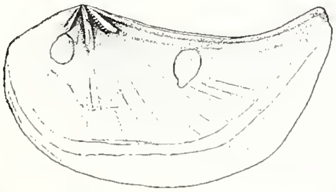
1. Shell subquadrate, very compressed; right valve concave, much smaller than left valve.
2. Both valves with a strong, scabrous ridge extending along the posterodorsal margin.
3. Posterodorsal margin straight, not curving.

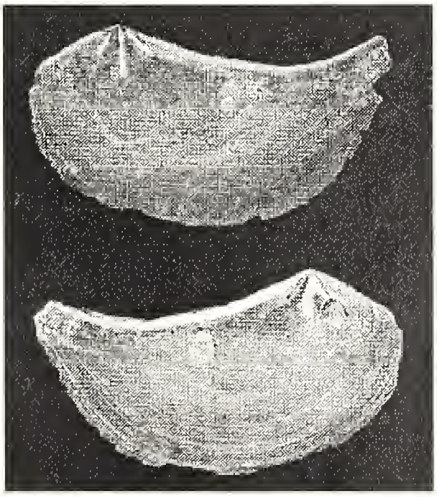
Distribution

Gulf of Thailand

Similar Species

The juvenile specimens from this study cannot be confidently placed within a described species, owing in part to the distinctive scabrous ridge along the posterodorsal margin. This ridge may not persist in the adult, in which case the Thailand species might be closest to *Pandora ceylanica* Sowerby, 1835 (see Oliver, 1992: p. 208).





Pandora ceylanica Sowerby, 1835
Illustration and photograph from Oliver, 1992

Eximiothracia cf. *concinna* (Gould, 1861)

Literature

Oyama, 1980 (pl. 57, fig. 19)

Diagnostic Characters

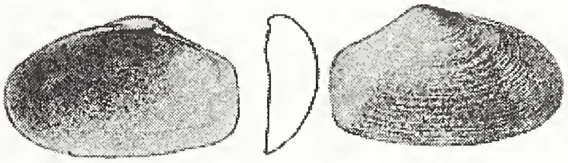
1. Shell subquadrate, very inflated; posterior strongly truncate.
2. External sculpture of fine granules over entire surface; ridges or other surface ornamentation absent.
3. Subequilateral, posterior end slightly longer.

Distribution

Indo-Pacific; Japan, Gulf of Thailand

Similar Species

Only a single small specimen was collected during this study. The Thailand specimen has a longer posterior end, whereas the specimen illustrated by Oyama (1980) has a longer anterior end. This may be a result of the relatively small size of the Thailand specimen.



Eximiothracia concinna (Gould, 1861)
Illustrations from Oyama, 1980

Verticordiidae sp. A

Literature:

none

Diagnostic Characters

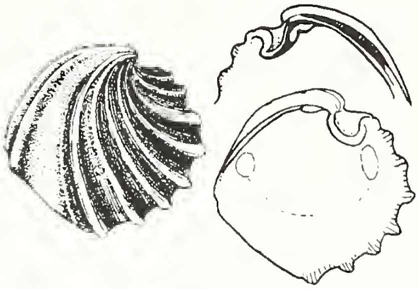
1. Shell ovate, very inflated, very thin-shelled, transparent; prodissoconch very large.
2. External sculpture of very fine, closely-spaced radial lirae.
3. Posterodorsal margin with distinct sulcus (elongate furrow).

Distribution

Gulf of Thailand

Similar Species

Two specimens of this species were collected in the Thailand study. They present a very perplexing puzzle, as all reported verticordids in the region are found at depths greater than 500 meters. This author can find no comparable described genus or species for the Thailand specimens.



Verticordia sp.
Illustrations from Keen & Coan, 1974

Cardiomya singaporensis (Hinds, 1843)

Literature

Lynge, 1909 (p. 193, text figs.)

Diagnostic Characters

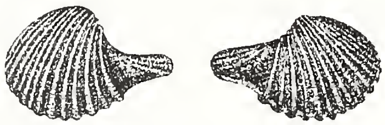
1. Shell inflated, ovate, rostrate; beaks strongly opisthogyrate (pointing posteriorly); posterior rostrum abruptly truncate.
2. External sculpture of strong, widely-spaced, sharp radial ribs over central disk.
3. Rostrum with three distinct radial ribs extending from beaks to the posterior margin.
4. Inequilateral, posterior much longer; rostrum long.

Distribution

Indo-Pacific; Singapore, Gulf of Thailand.

Similar Species

Cardiomya gouldiana (Hinds, 1843) has a shorter rostrum, and lacks the three radial lines on the rostrum.



Cardiomya singaporensis (Hinds, 1843)
Illustration from Lynge, 1909

Plectodon cf. *ligula* (Yokoyama, 1922)

Literature

Oyama, 1980 (pl. 57, figs. 21-22)

Diagnostic Characters

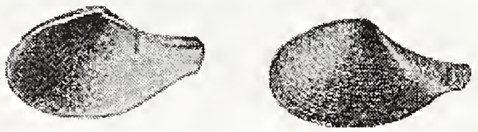
1. Shell elliptical, rostrate; inequilateral, posterior longer.
2. External surface granular.
3. Rostrum straight, not curved.

Distribution

Indo-Pacific; Japan, now Gulf of Thailand

Similar Species

The rostrum of the Thailand specimens is straighter and less demarcated compared to the Japanese type figured in Oyama (1980).



Plectodon ligula Yokoyama, 1922)
Lectotype (left), paralectotype (right)

Austroneaera cf. *semipellucida* (Kuroda, 1848)

Literature

Hanshin, 1986 (pl. 32, figs. 3-4)

Diagnostic Characters

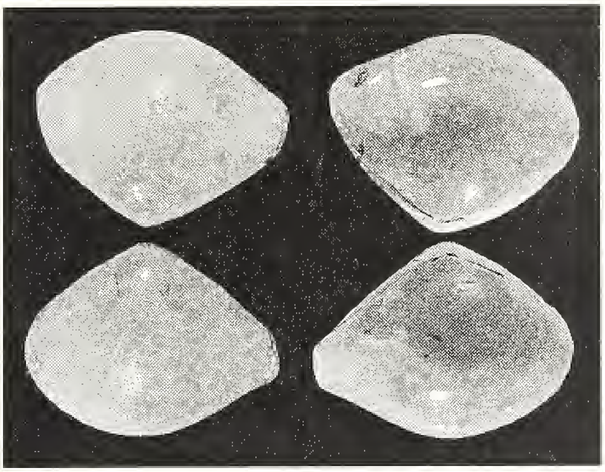
1. Shell subtrigonal, subequilateral, inflated, white; sturdy for size.
2. Right valve with one anterior and one posterior long lateral tooth.
3. Left valve without teeth.

Distribution

Japan, NE Pacific (Washington), now Gulf of Thailand

Similar Species

No other members of *Austroneaera* have been reported from the region. The long lateral teeth only found in the right valve, separate it from other cuspidariids.



Austroneaera semipellucida (Kuroda, 1848)
Illustrations from Hanshin, 1986 (types?)

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THE FESTIVUS

A publication of the San Diego Shell Club

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Meeting date: third Thursday, 7:30 PM
Room 104, Casa Del Prado, Balboa Park

COME TO THE AUCTION/POTLUCK
Saturday evening, April 22, 1995
at the Summerhill Clubhouse
6:00 p.m. - ???
(See map on last page for details.)

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Map for detaching

CLUB NEWS

It's Auction Time!

Saturday evening April 22nd is the date. Wes Farmer's Clubhouse is the place and 6:00 p.m. is the time! [See map on last page for details.]

As usual, festivities begin with an "attitude adjustment hour" featuring "Dave's Punch" while members pick up their auction lists and peruse the wonders laid out for the auction as well as viewing the silent auction tables. At 7:00 p.m. the potluck dinner will begin and the auction will start promptly at 8:00 p.m.

Remember, that besides being the "most fun" social event of the year, the auction raises much of the funding for the many activities and projects the Club sponsors. If you have not donated, there is still time to contact a board member and arrange for pickup. Out-of-town members and friends are also urged to donate specimen shells with collecting data or shell-related items to the auction.

If you have not signed up for a potluck contribution or made a donation for the auction, please contact Carole Hertz [(619)277-6259] or any other board member. Don't miss the auction/potluck. There are wonderful surprises in store and it's just too much fun.

From the Minutes
San Diego Shell Club Meeting - March 16, 1995

The meeting was called to order at 7:35 p.m. by President Kay Klaus. Kay announced that the Club still needs a volunteer to be host/hostess. Contact Kay [(619) 292-4527] if you are willing to volunteer.

A sign-up sheet was passed around for the Auction/Potluck and Kim Hutsell reported that donations are still needed. Kim also announced that COA registration flyers were available as well as survey forms for members to complete. Club name badges are available through the Hutsells for a cost of $1.00 each.

Silvana Vollero read the minutes of the February 16th meeting which were approved as read.

Jules Hertz shared recent publications sent to the Club. Bill Romer had Club publicity flyers available for distribution and he also had maps for the El Golfo trip scheduled for the weekend of 17-19 March.

A mini-auction of four books followed the business meeting.

Kim introduced the program for the evening. Speaker and Club member Don Pisor shared some fascinating slides from his October trip to Tanzania. The presentation included photos from his short safari in the southern end of the country as well as photos from Zanzibar and a beautiful display of shells from the area. It was enjoyed by all.

Kay invited all members to gather at 9 p.m. for some small group conversation on African shells. The meeting was adjourned at 8:45 p.m. Bill Kent won the door prize and the evening's refreshments were brought by Ginny Ward and John LaGrange.

Silvana Vollero

A Gift to You from the Club

You probably have noticed something extra in the envelope with your copy of **The Festivus**. As an expression of the Club's appreciation for your support, a San Diego Shell Club laminated bookmark has been enclosed with your April issue. Additional bookmarks are available at $1.00 apiece. To order, contact Kim and Linda Hutsell (619) 294-3914.

Correcting a Goof

In the March issue of **The Festivus**, the phone number for Conchologists of America (COA) chairman Don Pisor was listed incorrectly. The correct number is (619) 279-9342. It is hoped that this error did not cause undo consternation for those wishing to contact Don concerning the upcoming COA convention in San Diego from June 23-28th. The FAX number (619) 234-0250 was listed correctly.

The Bizarre Bazaar is Postponed

Because the Pacific Shell Club's "Sea Shell Show," scheduled for Sunday May 7th, conflicts with the date of the Club's annual Bizarre Bazaar, and many Club members wished to attend both functions, the Bazaar has been postponed. A new date will be announced at the Auction and will be published in the May issue of **The Festivus**.

There is no regular meeting this month.
See you all at the Auction/Potluck!

VICTORIA'S SECRET
(FINDING *COLUBRARIA PROCERA*)

MICHAEL SMALL

Embajada de Canada, Apartado Postal 105-05
Mexico, D.F. 11580, Mexico

Canadians still celebrate Queen Victoria's birthday - 93 years after her death. I spent Victoria Day weekend (May 21-23, 1994) in Zihuatanejo, Guerrero, Mexico, looking for the kinds of common coastal shells that were absent from my recent trip to Clipperton. At the end of a day diving with the Zihuatanejo Scuba Center, the dive master, Juan Manuel Barnard, pulled a strange fresh dead shell out of the pocket of his bouyancy compensator. "I think it is a *Terebra*, he said, as he gave it to me." I knew it was not, but it wasn't until I got home and looked it up in Keen (1971) that I discovered it to be a *Colubraria procera* (Sowerby, 1832).

Colubraria procera is by far the largest Panamic *Colubraria*; this specimen is almost 70 mm. The species was "lost" to science for over 130 years after Sowerby described it in 1832 from an immature specimen collected by Hugh Cuming. Keen (1971) restricted the species to the central Mexican coast around Manzanillo, but Shasky (1984) found it at Manabí Province, Ecuador. Keen based her locality information on four living specimens collected by Lawrence Thomas in 1967 near Manzanillo (Thomas, 1967).

Have any readers of **The Festivus** collected live *Colubraria procera*?

LITERATURE CITED

KEEN, A. MYRA
1971. Sea shells of tropical west America: marine mollusks from Baja California to Peru. Stanford University Press, i-xiv+1064 pp., ca. 4000 figs.

SHASKY, DONALD R.
1984. A preliminary checklist of marine mollusks from Manabí Province, Ecuador. Annual Report of the Western Society of Malacologists [for 1983] 16:25-32.

THOMAS, LAWRENCE
1967. Only one known specimen since 1832. I collected four in January. The Tabulata 1(1):1 & 6, 1 fig.

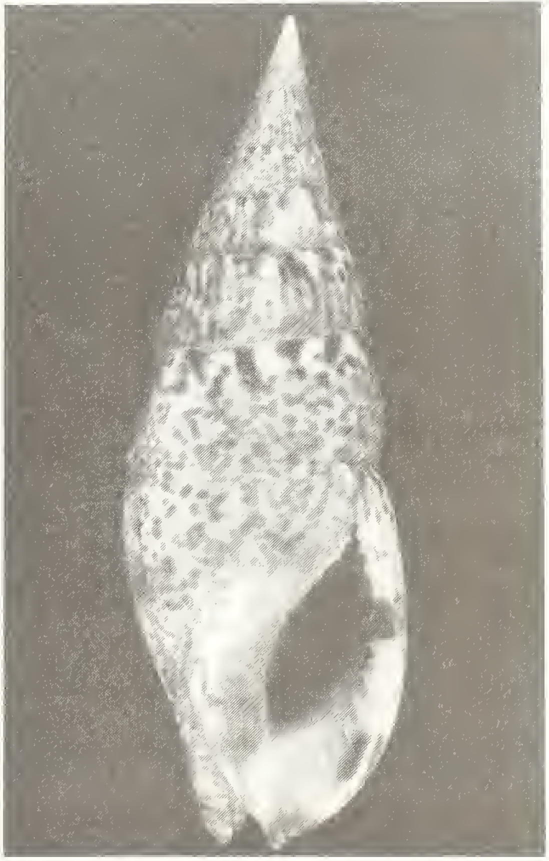


Figure 1. *Colubraria procera* Sowerby, 1832. Length: 69.3 mm, maximum diameter: 23.5 mm. Locality: Manzanillo, Mexico. Leg. Michael Small, May 21-23, 1994. Photo: D. K. Mulliner.

Editor's note: After Michael Small's paper above was ready for publication, Kirstie Kaiser reported collecting a juvenile (33.8 mm long) crabbed *C. procera* in sand under a rock while diving in 30 feet of water at Bahía Sam Houston, Bahía de Banderas, Jalisco, on 6 January 1995, extending the distribution north from Manzanillo.

A PROCESS FOR REMOVING STAINS FROM SHELLS

LARRY BUCK

13440 Portofino Drive, Del Mar, California 92014, USA

I'm writing this article -- the first of several -- as a sort of shell enthusiasts' public service announcement. It is upsetting to me that acids are still used occasionally to clean shells when superior alternatives exist. There is a simple process -- just short of miraculous actually -- for removing the iron staining (blackish, brownish or rust-colored) that exists commonly on many shells even after bleaching. This stain is usually either removed with acid or just oiled over. The stain I refer to happens to get on the shell in one of two ways. First, it can happen when a wet shell has been placed on a steel or iron surface, the subsequent rusting causing a stain on the shell's contact surface. I've seen the glossy bases of cowries stained badly in this manner and it can happen quickly. Secondly, and more commonly, many shells are stained by the substrate in their environment. I've often noticed the spires of deep-water volutes with a blackish deposit and many murexes and bivalves badly stained. White shells are prone to this staining.

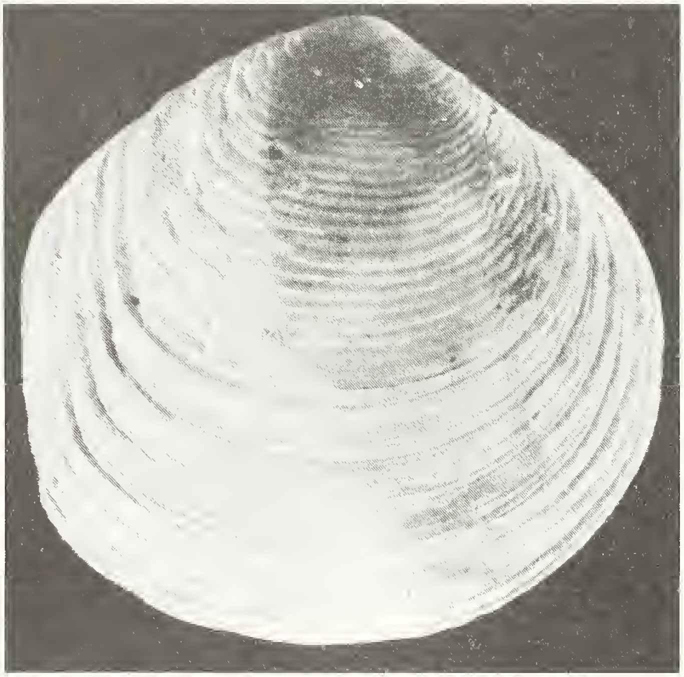


Figure 1. Valve of *Semele decisa* (Conrad, 1837) partially cleaned by using **Iron Out**. Photo: D. K. Mulliner.

Fortunately, this stain is usually not incorporated into the structure of the shell and can be removed rather easily. I'm sure someone will grump about this blasphemous contempt for the natural look. However, many collectors prefer that this stain be removed when possible -- if it can be accomplished without harming the shell. I developed this process after being faced with the arduous task of cleaning horribly stained, but otherwise fine, specimens from a badly polluted harbor. Everything from this location had varying degrees of staining. Many of the stains had progressed to the point that it appeared the shells had brown paint on them that could only be removed mechanically. I've removed the same type of deposit from a large Atlantic pecten with amazing results.

Most "rust stain" removers are acidic and will etch glossy shells. Amway Company's **Redu**, now discontinued, was non-acidic and worked well (see **The Festivus** 1991, vol. 23:58). Amway now has another product, **Iron Out** which is acidic, but when buffered works well. It is less costly than **Redu** and can be buffered quite easily with sodium carbonate or sodium bicarbonate. I use a thoroughly mixed solution of one tablespoon of **Iron Out** per two cups of warm to hot water, buffered with one half teaspoon of sodium carbonate or bicarbonate (baking soda). The only difference I've noted between the two types of buffers is that the baking soda suds up temporarily. Once mixed, the solution is ready to use and lasts a couple of days, gradually losing its effectiveness.

Before soaking, oils should be removed from previously oiled shells with soaps or solvents such as mineral spirits so that stains will not be protected from the effects of the solution. Soaking time can vary from as little as a few minutes to overnight on badly stained shells. Experiment first. I've left cowries in this solution several hours with no noticeable effect. Being overly careful, I never leave shells soaking for longer than need be.

After soaking, some specimens may have what looks like an area or spot with a blackish discoloration. This usually disappears when the specimen is allowed to air dry for at least a couple of days.

You'll be pleasantly surprised after cleaning to see gleaming white and subtle colors (Figure 1) become more noticeable -- sound like a laundry soap commercial? The purple color from within the spire of our local albino *Pteropurpura trialata* (Sowerby, 1841) really shows through beautifully, when cleaned by this method. I'm constantly amazed by the results from this process. It's actually almost as useful as bleach -- and it doesn't spot your shirts.

I hope you come to the same conclusion that I have, that acids cause more harm than good and that there are always better substitutes. Whether you choose to use this process or not, please let me know your comments or any additional information you may have.

My appreciation to Dave Mulliner for the photograph of the half-cleaned shell.

BOOK NEWS

Illustrated Catalogue of Recent Species of Muricidae Named Since 1971
By: Roland Houart
179 pages, 28 plates (8 in color), 25 text figures
Publisher: Verlag Christa Hemmen. 1994
Price: $59.95 (plus $4.50 postage in the USA)

This new and finely illustrated book on my favorite family of marine gastropods is a welcome addition to any library, whether collector or serious worker in the family.

As a whole, the shells of Muricidae have the most fanciful form and ornamentation and are numerous enough, both common and rare, to constitute a challenge to collectors and professional workers who care to admit that their shells as sculptural forms are fascinating. The sculpture of shell body, flanges, and often elaborate microsculpture of all surfaces applies to both large species not needing microscopic enlargement and to the smaller than half inch species in which intricacies and variations are very complex and beautiful. At least so they have enthralled me over a period of fifty years of study.

The illustrated catalogue is large enough in size so that both text and illustrations are easily studied. There are 288 plates of which eight are in full color. The often warm delicate colors show up very well on the uniform black background. The large number of new species, 380 illustrated, are those described after 1971. Most of these newly described species were obtained in large measure by dredging of one kind or another in the Philippines, Australia and to a lesser extent in the tropical seas worldwide. The dredging was done largely by commercial fishermen but the scientific exploration by scientists and public institutions as well as individual scuba divers also added much to our knowledge base.

In addition to the 28 plates, there are 25 text figures showing the nature of the protoconch, drawings which, because of the small size of the protoconch, need to be studied and drawn with the aid of a camera lucida. I do not believe that many seas have been thoroughly searched and we may all have the pleasure of keeping up with new discoveries.

In this work as in other illustrated books dealing with sea shells, the emphasis is essentially on shell characters. When and if their taxonomy will also be based on studies made by the various biological disciplines remains questionable. I do not hazard an opinion on when this will take place. My personal feeling is that the specific nature of the shell alone will prove, in most cases, to have been valid enough to warrant their being named. In all, Mr. Houart is to be commended for this lovely new addition to the illustrated literature on Muricidae.

Anthony D'Attilio

CHITON ALMOST SINKS SEATTLE AQUARIUM!

ROLAND C. ANDERSON

The Seattle Aquarium, 1483 Alaskan Way, Seattle, Washington 98101, USA

The Seattle Aquarium is fortunate to be located on a waterfront. This allows it to use ambient sea water in most of its cold salt water tanks. The water is pumped from Elliott Bay, Seattle's harbor, and filtered for clarity before passing through pipes to the exhibit tanks. The sand and gravel filters screen out particulate matter as small as 10 micrometers in diameter. Unfiltered sea water is pumped to several tanks of filter feeders where water clarity is not a concern. Unfiltered sea water is also directed to several large tanks at night, to feed filter feeders and for colonization of the tanks by planktonic larvae to give the tanks a natural look. The unfiltered water is shut off in time for the tanks to clear by opening time. Although a huge benefit to filter feeders and exhibit standards, some animals that have settled into a tank have caused problems, animals not normally considered to be problem animals.

Such incidents took place in the Dome tank, the Aquarium's premier exhibit tank. This is a circular tank 20 feet deep of 400,000 gallons capacity with a centrally located underwater "dome" inside. People walk into the dome and look out at the fish in the tank. The 105 windows of the dome are placed into concrete mullions (cross-bars). The windows are 1-1/2 to 3-1/2 inch thick plexiglass. They are set on a gasket of hard rubber and sealed with a bead of relatively soft silicone glue at the edges (Figure 1).

On three occasions in the last three years a window in the Dome has spontaneously started to leak (usually at night or on weekends!). The leaks have ranged from an infrequent drip to a downright stream of water. Divers sent into the Dome to discover the cause of the leaks have either found a chiton burrowed under the outer layer of sealant or one scraping a dimple in it, and the leaks were under the dimple. On one occasion, the chiton had dived into the sealant "nose first." Upon removing the chiton and adding new sealant, the windows stopped leaking. The chitons found to be doing the dirty work were *Tonicella lineata* (Wood, 1815). They had not been added to the tank, and so had to have entered the tank as plankton.

We don't know if the chitons were looking for food, hiding from daylight, or simply crawled there haphazardly. We do know that we now remove any chitons seen on or around the windows.

Many thanks to Elsie Marshall for confirming the identification of the chitons.

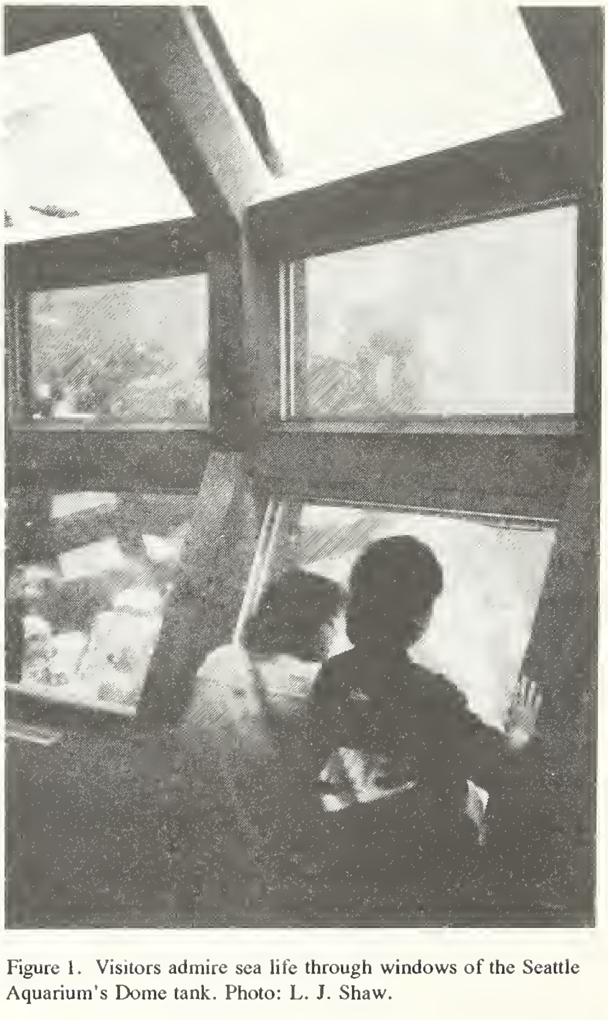
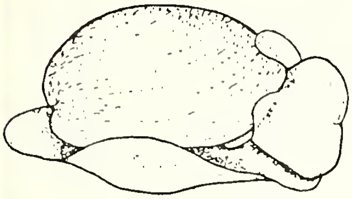


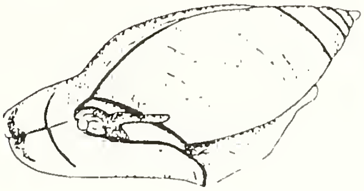
Figure 1. Visitors admire sea life through windows of the Seattle Aquarium's Dome tank. Photo: L. J. Shaw.

SAN DIEGO SHELL CLUB



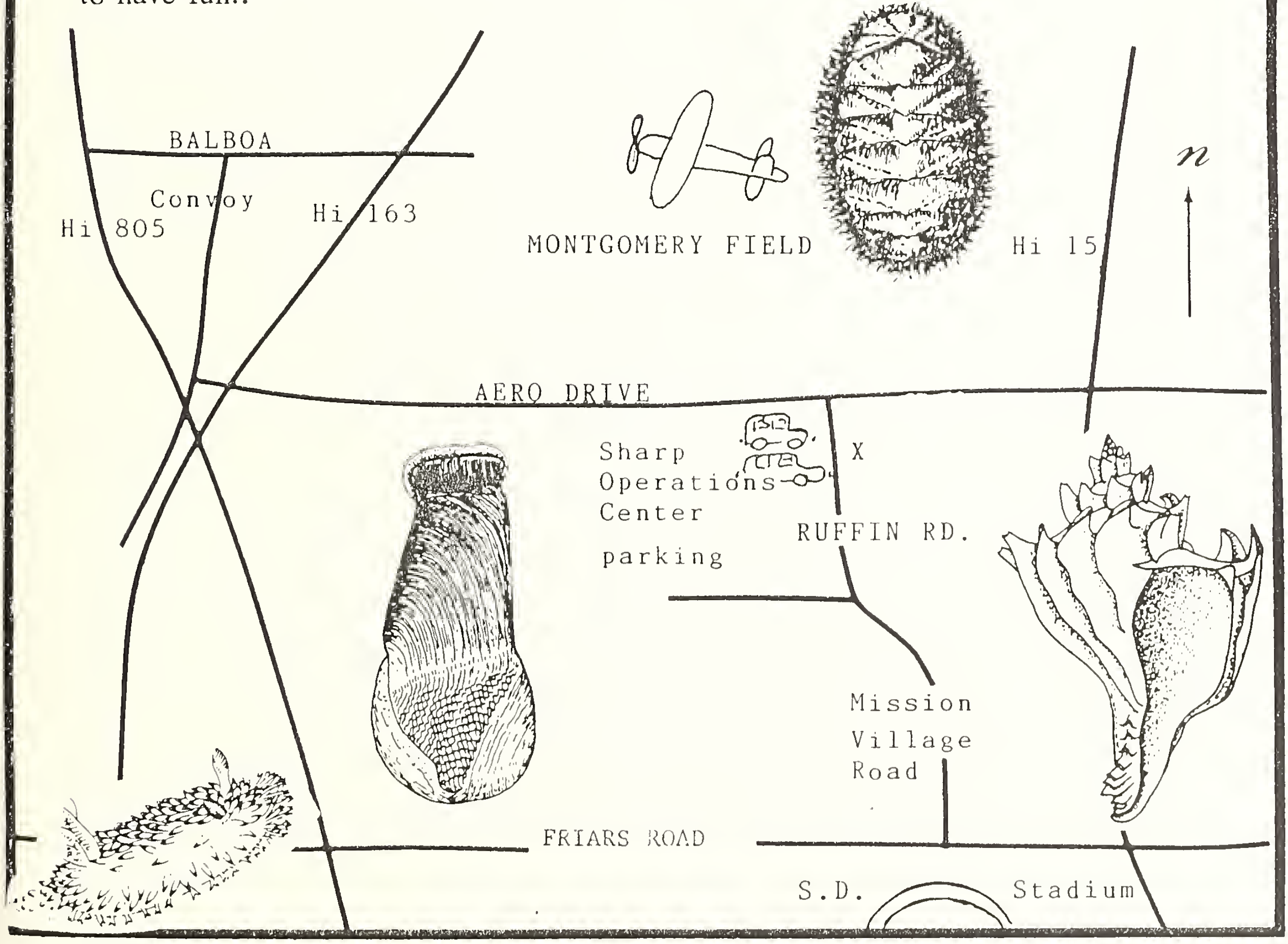
AUCTION/POTLUCK

APRIL 22, 1995



DIRECTIONS TO THE AUCTION: from 805: exit onto Balboa, east to Convoy, south to Aero Dr., east to Ruffin Rd., south about a block or two. Clubhouse on East side of street; park at Sharp Operations Center on West side.
From San Diego Stadium on Friars Road: up Mission Village Drive to Ruffin Rd., right turn or north about a half mile, parking on the west side of the street at Sharp Operations Center across from the Clubhouse.
THE ADDRESS: 3575 Ruffin Rd. at the Summer Hill Clubhouse.
TIME: 6:00 P.M. -???

REMEMBER TO BRING: Your potluck dish with serving utensils. Also, please bring eating utensils for yourself (plates, cups and napkins will be provided). And come ready to have fun!!



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THE FESTIVUS

A publication of the San Diego Shell Club

Volume: XXVII May 11, 1995 Number: 5

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Annual dues are payable to San Diego Shell Club. Membership (includes family): $12.00; Overseas (surface mail): $15.00; Overseas (air mail): $30.00.

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Meeting date: third Thursday, 7:30 PM
Room 104, Casa Del Prado, Balboa Park

PROGRAM

Rare and Classic Shells of the World

Kay Klaus, Club president who lived in the Philippines for a number of years, will present a slide program on rare and beautiful shells from her own collection. Over 140 slides will highlight these magnificent specimens.

Shells of the month: rare shells
Meeting date: May 18, 1995

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CLUB NEWS

The Auction/Potluck

The May Auction/Potluck was as successful as ever! Though the presence of our Club president, Kay Klaus, was sorely missed, many local and out-of-town collectors came out for the event. Everyone was especially pleased to welcome back the Vallis-- Adrian, Sherry and Dylan. The evening opened with informal conversation and shell viewing followed by a dinner of potluck contributions from all, including the infamous Dave's Punch and quite a selection of desserts.

Carole Hertz piqued everyone's interest in the bidding as she served as the lively auctioneer. Margaret Mulliner and Pat Boyd did a great job keeping track of all of the items. The cowries were the most hotly valued shells, bringing about active bidding. The prize of the evening was a lovely framed drawing of an *Ocenebra barbarensis* by Tony D'Attilio. Over 200 shells and shell-related items have found new homes with Club members and their guests.

Special thanks to Wes Farmer for hosting the event at his Clubhouse once again. We are also grateful to everyone who helped in organizing the party, bagging and tagging the shells, and setting and cleaning up. Last, but not least, the Auction would not have been possible without the generous donations of all those listed below.

See you next year for another fun-filled shell extravaganza.

Silvana Vollero

Those who donated to the Auction are as follows: Terry Arnold, Susie & Bob Boyd, Pat & Ed Boyd, Marge & Hugh Bradner, Twila Bratcher-Critchlow, Billee Brown, Larry Buck, Larry Catarius, Fred Closson, Karen Couch, Wes Farmer, Carole & Jules Hertz, Linda & Kim Hutsell, John Jackson, Kirstie Kaiser, June King, Kay Klaus, John LaGrange, Debra Levin, Marge & Ken Lindahl, Margaret & Dave Mulliner, Rick Negus, Lach Noyes, Rosemary & Frank Pierce, Bob Pike, Jeanne & Don Pisor, Chuck Reitz, Wally Robertson, Bill Romer, Nancy & Bill Schneider, Don Shasky, and Gladys Weber. Our thanks to all of you.

The 1995 Greater San Diego Science and Engineering Fair

This is the 24th year that the San Diego Shell Club has participated in the Greater San Diego Science and Engineering Fair. The committee (Hans Bertsch [chair] and Carole and Jules Hertz) selected as Club winner, John Decker Forrest, a tenth grader at Helix High school for his project, "Zonal Choice of the Limpet *Collisella limatula*."

John, a first place winner in marine biology, will present an overview of his project to the Club at a future meeting. At that time he will receive his Club prize, a book award from a choice of three books in the area of marine biology, **Between Pacific Tides, Intertidal Invertebrates of California** or **Invertebrate Zoology**.

New Date for the Bizarre Bazaar

The sixth annual Bizarre Bazaar will be held on Sunday May 21st in the garden of Sheryl and Rick Negus at 3401 Woodland Way in Carlsbad beginning at 1:00 p.m. The Bizarre Bazaar is great fun so try to attend. Bring a table or stand for your shells and be prepared to enjoy trading, buying and selling or just plain admiring and socializing. For further information and/or directions, call Rick Negus (619) 434-9808.

Club Shirts for Sale

The Club now has custom-designed t-shirts and sweatshirts for sale. As those members who attended the auction/potluck have already seen, the Club's new shirts, designed by Suzanne Parlett, are smashing. Those who attended the Christmas Party and the January meetings saw the shirt design and now they are available.

Members were able to order the shirts at the auction and they will also be on sale at the May meeting The t-shirts are available in either black or ash (pale gray) in sizes M, L, XL and XXL. The t-shirts are each $15.00 (XXL @ $17) and the sweatshirts, available in ash, are $25 (XXL @ $27).

Following the sale at the May meeting, the shirts, will be sold at the upcoming COA meeting. It is expected that they will sell out then, so get your order in now. Contact Kay Klaus [(619) 292-4527] for further information.

STUDY OF A POPULATION OF *FORRERIA BELCHERI* AND NOTES ON THE SPECIES

JULES & CAROLE M. HERTZ[1]

Associates, Santa Barbara Museum of Natural History, 2559 Puesta del Sol Road,
Santa Barbara, California 93105, USA

INTRODUCTION

Forreria belcheri (Hinds, 1844), the largest muricid found in Southern California (Figure 1), has a reported distribution from Mugu Lagoon, California, to Scammons Lagoon, central Baja California, Mexico (McLean, 1978), with the type location being San Diego, California. Orcutt (1885) wrote that *belcheri* "were formerly abundant at San Diego (during the early whale fisheries), where it is now rare. Common at Todos Santos Bay." Kelsey (1907), in his list of mollusks collected in San Diego, stated *belcheri* were "Dredged. Quite common; generally drawn up in nets of fishermen." Glass & Foster (1986) reported its occurrence at Santa Barbara, California, and it has also been reported off Cedros Island, Mexico (Anon., July 1972). Abbott (1974) listed the northern boundary as Morro Bay, California. Kool (1993) evaluated the anatomy and radula of a specimen at the United States National Museum which had been taken off San Francisco, California. *Forreria* is "usually found offshore in relatively shallow water of 18-30 m (60-100 ft) and within bays and lagoons, where it is occasionally exposed at low tide" (McLean, 1978). Glass & Foster (1986) cite reports of its occurrence out of Santa Barbara Harbor in about 12 m (40 ft) on silty sand, the species fluctuating between being moderately common and exceedingly rare. They speculated that this may be "a case of periodic migrations from deeper water."

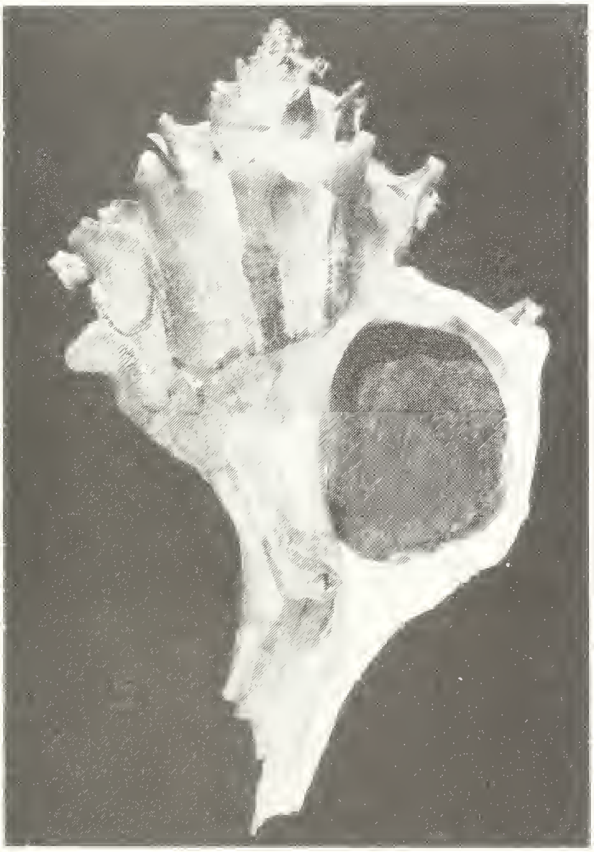

Figure 1. *Forreria belcheri*, apertural view, 132 mm long. Photo: D.K. Mulliner.

The effects on molluscan populations caused by pollution and dredging of harbors and the loss of estuaries and lagoons through natural occurrences and commercial ventures is of great concern. It was brought to our attention in 1992 by Charles Waters, Redondo Beach, California, that the Old Navy Fuel Dock (Figures 2 & 3) at Los Angeles Harbor, San Pedro, California, was to be torn down, the surrounding area dredged and a marina built in that location. There was a good chance that a large population of *F. belcheri* and other species such as *Kelletia kelletii* (Forbes, 1852), *Pteropurpura festiva* (Hinds, 1844), and

---

[1] Mailing address: 3883 Mt. Blackburn Ave., San Diego, CA 92111, USA.

Figures 2 & 3. Old Navy Fuel Dock, Los Angeles Harbor, San Pedro, California, (2) overall view (3) view of area of Dock where divers entered the water. Photos: J. Jackson.

Roperia poulsoni (Carpenter, 1864), would be lost. A project was conceived by Kim Hutsell to survey and study the *Forreria* population in this area prior to the proposed dock removal and dredging. A team of five members was established to work on the project. Larry Buck and Kim Hutsell led the activities, with Larry Buck responsible for bringing the specimens to shore and Kim Hutsell for making measurements and recording data. Dave Mulliner conceived the tagging methodology, participated in the specimen tagging, and was responsible for photography. Jules and Carole Hertz were to research prior literature on *F. belcheri* and report the results.

SYSTEMATICS

MURICIDAE Rafinesque, 1815

OCENEBRINAE Cossmann, 1903

Forreria Jousseaume, 1880

Type species: *Murex belcheri* Hinds, 1844, by original designation

Forreria belcheri (Hinds, 1844)

Murex belcheri Hinds, 1844a:127; 1844b:8, pl. 2, figs. 1-3.
Pyrula belcheri: Reeve, 1847, vol. 4, pl. 2, fig. 4.
Chorus belcheri: Tryon, 1880, ser. 1, vol. 2:198, pl. 61, fig. 309; Orcutt, 1885:536; Kelsey, 1907, vol.1(2):37.
Forreria belcheri: Dall, 1921:113; Grant & Gale, 1931:726; McLean,1971:44 (1978:44); Abbott, 1974:171; Kool, 1993:227-229.
Rapana (Forreria) belcheri: Thiele, 1929:288; Wenz, 1941:1084.

Kool (1993) changed the placement of *Forreria* from Rapaninae Gray, 1853, to Ocenebrinae Cossmann, 1903, based on a cladistic analysis using 18 characters derived from the protoconch, shell ultrastucture, operculum, mantle cavity complex (ctenidium, osphradium), female and male reproductive and alimentary systems, and radula.

METHODOLOGY

The project methodology consisted of retrieving as many animals as possible on the project team's first visit to the site; tagging the shell of each animal in such a way that it would not hinder or be detrimental to the animal; recording the length, width, weight, aperture color, protoconch/spire erosion or damage, as well as miscellaneous remarks; notching the shell lip of each animal in the same location; and returning the animals to their habitat. At periodic intervals, the site would be revisited, animals captured, and data recorded on any tagged specimens that were recaptured. In addition to the parameters above, shell lip growth would also be measured on recaptured animals.

The shells of the animals were tagged on the flat portion of the upper body whorl by coating the area with a seagoing epoxy putty available from Permalite Plastics Corporation, Newport Beach, California, and a metal stamping set was used to produce a number on each shell (Figures 4 & 5). After stamping the number, the shell was returned to the harbor and the epoxy cured by the presence of the water. A rechargeable Dremel tool with a diamond bit was used to grind a V-shaped notch on the outer lip of each shell. This notch was used as a reference point for measuring lip growth on recaptured animals (Figure 6). Length and width measurements were made with a calipers to a hundreth of a mm and these were then rounded to the nearest 0.1 mm. Length of each shell was measured from the tip of the spire to the tip of the siphonal canal. The width of each shell was measured in a plane perpendicular to the columella immediately below the spines on the body whorl. Weight of each animal was only determined during the initial tagging process, since it was obvious that retained water by the animals would be variable and the notching and tagging process would also affect the weight. Weighing was accomplished using a triple-beam balance after drying the outside of the shell. Color and overall assessment of shell damage were recorded using an arbitrary scale of 0 to 4, with 0 representing none, 1 some, 2 average, 3 above average and 4 intense. Additional remarks were recorded as to the presence of barnacles on the shell or the existence of specific shell damage, such as broken spines or broken siphonal canal.

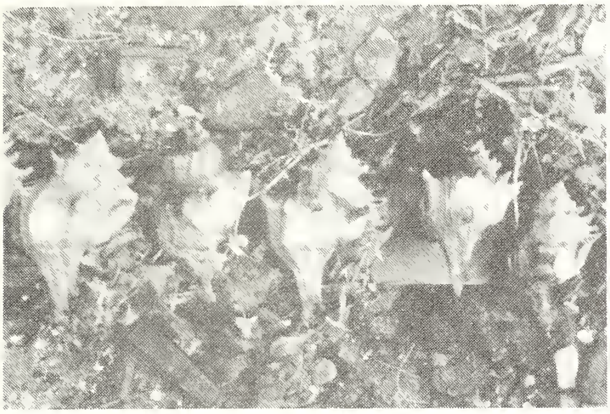

Figure 4. Series of tagged *Forreria belcheri* awaiting return to the collecting site. Photo: D. K. Mulliner.

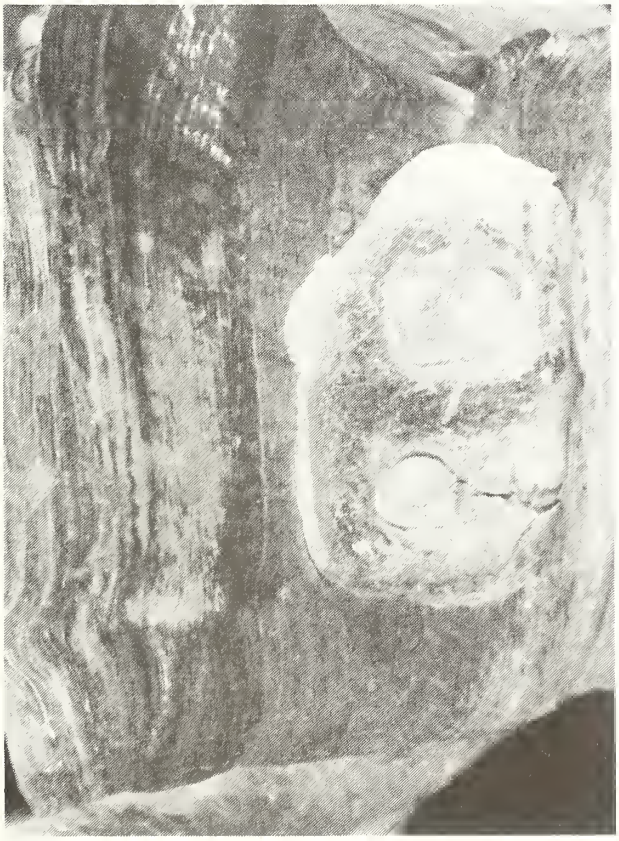

Figure 5. Close-up of tagged area of *F. belcheri* showing stamped number. Photo: D. K. Mulliner.

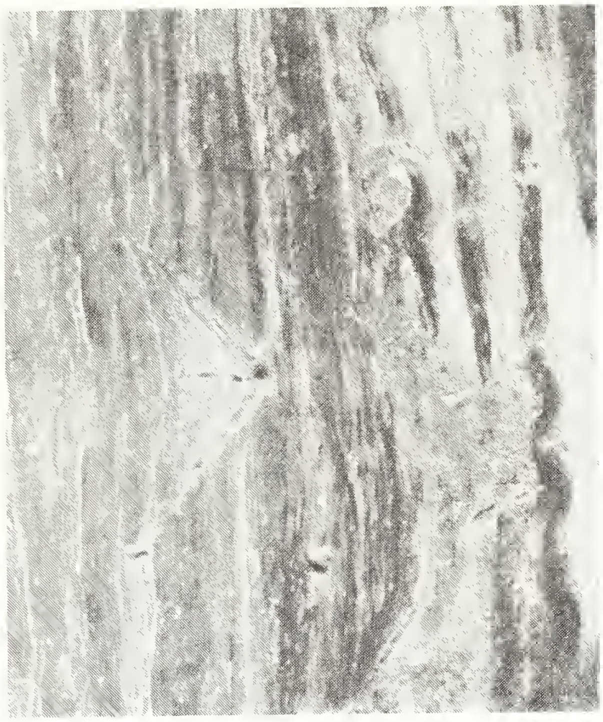

Figure 6. Close-up of notched lip of recovered specimen of *F. belcheri* and new lip growth. Photo: D. K. Mulliner.

DISCUSSION

Forreria belcheri, in great numbers, were first found at the site of the Old Navy Fuel Dock, Los Angeles Harbor, San Pedro, California, on 25 November 1990 by Larry Buck, Charles Waters, Rick Negus and John Jackson. The Dock supported by pilings was approximately 0.4 km (0.25 mi) long and 18 m (60 ft) wide and paralleled the shoreline; the innermost pilings going into the shore and the outermost sunk in about 6 m (20 ft) of water. The site was revisited on 13 September 1992, prior to the start of the "*Forreria* Project," by Larry Buck and Dave Mulliner, but there were fewer *Forreria* present on that date. Diving at the site was described by Dave Mulliner as "diving in a sewer." The bottom was muddy, oozy silt, and every time a diver turned a *Forreria,* he would be enveloped in a black cloud. The bottom was littered with trash including bottles, cans, paper products, metal debris, ropes and cables. The water smelled of gasoline, and so did the divers when they emerged from the water. The divers were following a strict protocol of not removing their regulators or face masks under water, for fear of exposure to various types of contaminants, and washing thoroughly with fresh water as soon as possible after their return to shore. Visibility at the site was highly variable; one time it was less than 30 cm (1 ft), while on another dive it was greater than 9 m (30 ft).

The most prevalent gastropod on the silty bottom was *Kelletia kelletii* which occurred there in the hundreds at 3-11 m (10-35 ft). *Forreria belcheri,* a much rarer species, was the second most prevalent gastropod on the silty bottom, primarily in 9-11 m (30-35 ft) of water, with a few found feeding on mussels in 8 m (25 ft). On some collecting days more than 100 *Forreria* could be counted. The *F. belcheri* fed on *Mytilus californianus* Conrad, 1837 (Figure 7), which were sloughing off the pilings and were also on metal debris and the riprap in the area. This area was approximately 3 m (10 ft) beyond the outermost edge of the Dock; the outermost pilings being in 6 m (20 ft) of water. *Forreria* were never seen below the Dock. On the rocks surrounding the base of the pilings, one could find *Pteropurpura festiva* and occasionally *Pteropurpura trialata* (Sowerby, 1841) and *Roperia poulsoni*. Also present in the area were *Crassadoma gigantea* (Gray, 1825), *Chama arcana* Bernard, 1976, *Leptopecten latiauratus* (Conrad, 1837), *Laevicardium substriatum* (Conrad, 1837), *Rictaxis punctocaelatus* (Carpenter, 1864), a *Simnia vidleri* (Sowerby, 1881) on a small piece of gorgonian, and about 6-7 species of nudibranchs.

The "*Forreria* Project" officially began on 18 November 1992, when all visible specimens at the site were collected by Larry Buck and the specimens examined, measured, weighed and tagged by Kim Hutsell and Dave Mulliner and then returned to the collecting site. On this day, at a depth of 9 m (30 ft), visibility was almost non-existent, *i.e.* 10-30 cm (4-12 in); a total of 40 specimens were captured, and the data obtained appears in Table 1. All of the specimens were adult or sub-adult. Some smaller specimens, having lengths of 65-75 mm, were found on other sampling days, but, despite extensive searching, no juvenile specimens were ever observed. Charles Waters (pers. comm.) reports a number of juvenile animals, 50 mm and greater, were taken in April 1981 by a halibut fisherman off Pt. Fermin, California, using a gill net at 34 m (110 ft). Kim Hutsell has a series of juvenile *F. belcheri*, 18-33 mm in length, which were collected dead by Roger Evans in January 1979 off Redondo Beach, California, at a depth of 18 m (60 ft), with approximately half the shells having 2-3 mm concave drill holes. Perhaps juveniles can only be found in deeper water.

It was the intent of the "*Forreria* Project" to make periodic dives at the collecting site until the Old Navy Fuel Dock was demolished and the area dredged. The site was revisited on 23 September and 2 November 1993 and 4 June and 15 September 1994. Animals were gathered and examined. Tagged specimens that were found were remeasured for length and lip growth. Some shell damage was encountered in transporting the shells to shore and back again to the collecting site. Kim Hutsell stated that he had never encountered a gastropod with a shell as brittle as the *F. belcheri*. Because of breakage of the siphonal canals, some specimens were shorter in length when remeasured. All animals that were recaptured showed some lip growth, although very minor in most cases. This was attributed to the initial maturity of the tagged specimens and the relatively small period of time between initial tagging and subsequent recapture. There was no correlation of lip growth with either initial shell length or width. The greatest growths occurred on two of the shorter, sub-adult specimens, but other animals with approximately the same initial dimensions showed negligible growth. Two of the recovered specimens showed large increases in shell length, but no appreciable lip growth. This may be attributed to repair of siphonal canals, since the shells are very brittle and show many areas of repair. The animals did a good job of filling in the notch, and it was difficult to find the notch on recaptured animals even when using a hand held magnifying glass.

Growth may be a function of food availability, feeding habits, the last occurrence of growth and animal

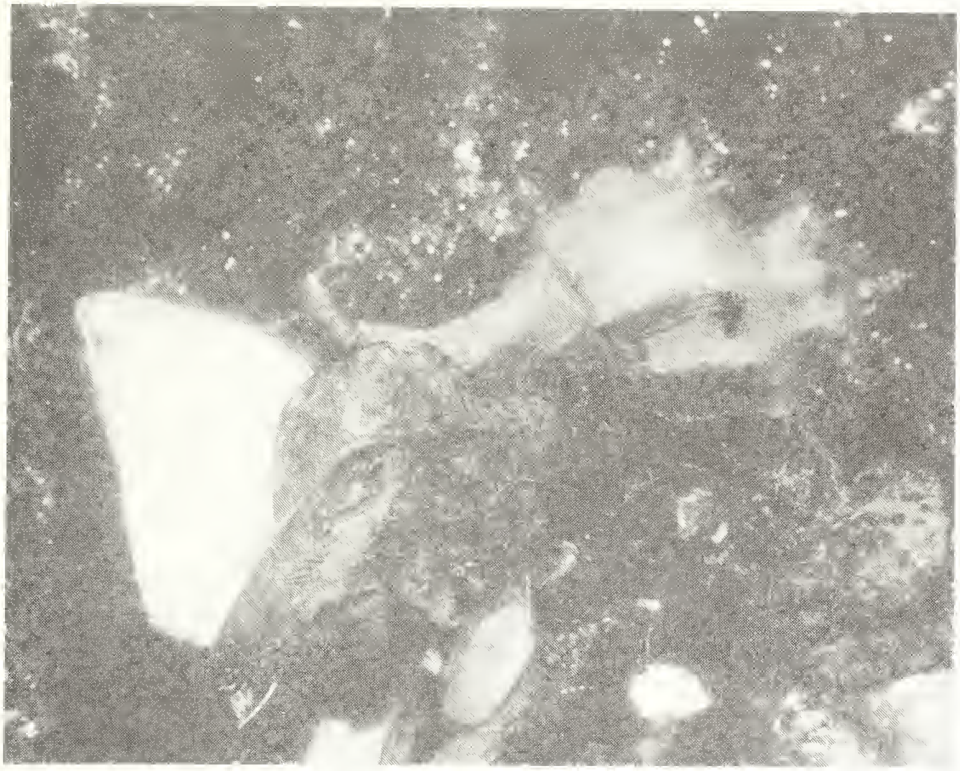

Figure 7. *Forreria belcheri* specimen feeding on *Mytilus californianus*. Photo: D. K. Mulliner.

maturity. There appeared to be large numbers of mussels as well as other bivalves available as a food supply at the project site, but the *Forreria* were only observed feeding on the *Mytilus*. Athough there were several piles of mussels which had sloughed off the outermost pilings into deeper water, the *Forreria* seemed to select one pile and feed together. This may indicate some chemical attraction which is received by all the animals at one time. There is some literature available on the feeding habits of *Forreria*, but only in captivity. Burghardt (1970:89-90) reported on a *F. belcheri* specimen (139.1 mm) captured in 1967 in Newport Bay, California, and kept at the Steinhart Aquarium, San Francisco, for a period of seven months. After nearly four months, the animal was transferred to a 140 x 38 x 38 cm tank and a live *Chione* clam (51.0 mm) was introduced. Burghardt reported that the *Forreria* moved directly to the *Chione*, engulfed it, and jerked back and forth using the outside lip of its shell to wedge open the clam. The *Forreria* remained on the clam for three days and then moved off an empty shell. Two small chips could be observed on the outer edges of the *Chione* valves. This type of feeding continued for three months, with freshly thawed whole prawns being substituted on occasion. The time required by the *Forreria* to find newly introduced food ranged from 12 to 65 minutes. The *Forreria* were fed twice a week, but died after seven months in captivity. Human (1971:80) kept eight *F. belcheri* alive in an aquarium for over a year without feeding them. At the end of this period each animal was fed a *Tivela stultorum* (Mawe, 1823). All the *Forreria* died within three days; apparently, their digestive systems could not adjust to the sudden abundance of food. Williams (1976:141) reported on the feeding activities of a juvenile (34 mm) *F. belcheri* in an aquarium. In the period of three months it had grown to 47 mm and added 3½ new knobs on the body whorl; all this on a diet of mussels and clams. In each case, the *Forreria* drilled a concave hole through the shell of the prey, and the interior was rough in appearance. The top of the hole was about 2 mm in diameter and the bottom about 1½ mm in diameter. The *Forreria* drilled empty shells and those occupied by hermit crabs, as well as those that housed live animals.

Kool (1993) evaluated the protoconch, shell ultrastructure, operculum, anatomy and radula of *Forreria belcheri*. He figured scanning electron micrographs of the protoconch, radula and shell ultrastructure, as well as a photograph of the shell and the operculum. The SEM photographs of the radula include a section of the ribbon and a portion of the rachidian row. Figure 8 is a drawing by A. D'Attilio of a radula from a juvenile *Forreria belcheri*.

The sudden appearance and then disappearance of large numbers of *Forreria belcheri* were discussed by Glass and Foster (1986), who speculated that this phenomenon may result from periodic migrations to deeper water. On one dive when the visibilty was very good, Larry Buck observed the *F. belcheri* at the ends of long trails, coming in from deeper water. These

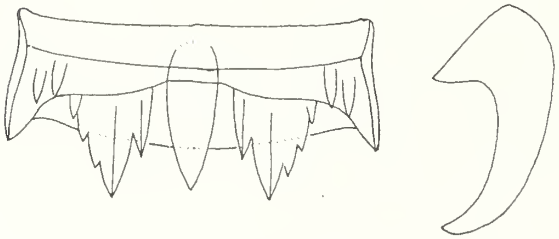

Figure 8. Drawing of radula of juvenile specimen of *F. belcheri*. Drawing by A. D'Attilio.

trails extended for more than 9 m (30 ft). On another occasion, one of the tagged specimens was found approximately 61 m (200 ft) from where it had been placed. These incidents are indicative of the great mobility of these animals.

On the first revisit to the site by members of the team (23 September 1993), approximately 130 *F. belcheri* were found, but only seven were tagged specimens. Measurements were made and recorded (see Table 1), and the animals were released. Two of the *F. belcheri* had the eggs of *Kelletia kelletii* on their dorsums. Removal of the Dock was initiated in February 1993 and completed in December 1993. Figure 9 shows the appearance of the site in December 1994 after the removal of the Dock. On 2 November 1993, when the removal project was essentially completed, Larry Buck revisited the site and saw about 35 *F. belcheri*. Only one tagged specimen was found, approximately 61 m from the release site. On 4 June 1994, Larry Buck found 89 specimens at the site, nine of which were tagged. These were remeasured and eight were released. The ninth had its tag dangling from the byssal threads of a mussel and it was not released at the site. One of the *F. belcheri* from this day had egg capsules on its dorsum, but again they were those of *K. kelletii*. The final visit to the site was on 15 September 1994. Despite the fact that the pilings had been removed almost a year earlier and there were large holes in the substrate, approximately 50% of the mussels were still present at the collecting site. The area had not been dredged, and it now appears that dredging has been postponed. Only one small dead *Forreria* was found. The animals had either been collected, migrated to other sites or had buried themselves. There are other docks and similar sites in Los Angeles Harbor, and it is possible that the animals have moved to a similar site in the general vicinity. All of the data is reported in Table 1. Even though there are no obvious conclusions about growth, it is significant that 17 of the 40 tagged specimens (42.5%) were recovered live at later dates.

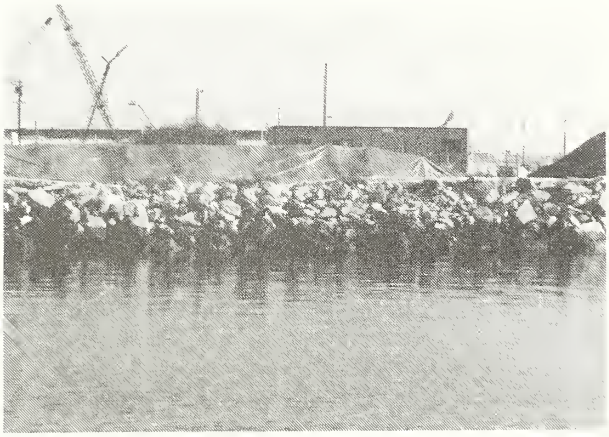

Figure 9. Appearance of site after Dock removal; sand gathered from this area of shore is under plastic awaiting decontamination. Photo: C. Waters.

D'Asaro (1991) compiled what is known about muricid egg capsules with detailed illustrations and data extracted from specimens in Gunnar Thorson's worldwide collection of Muricidae egg capsules. Included were the egg capsules of *Forreria belcheri*. Shown were an egg mass from southern California and side, lateral, and apical views of an ampulliform egg capsule. The figured egg mass was taken by G. E. MacGinite at Corona del Mar, California. D'Asaro reported that the *Forreria belcheri* egg capsules contained from 1250-1500 embryos per capsule. Figure 10 is a photograph of preserved *F. belcheri* egg capsules (SBMNH 25538) taken in 1956 by J. E. Fitch from a trawler in 4-6 m (12-18 ft) off Belmont Shore, Long Beach, California, and Figure 11 is a side view of one of the ampulliform egg capsules from that egg mass. The egg capsules in Figure 10 have a tan color with wine-colored blotches. Figures 10 & 11 match the *Forreria belcheri* egg capsule illustrations in D'Asaro (1991).

SUMMARY

The study continued for almost two years, but there were no large amounts of growth noted in the recaptured animals. Of the 40 specimens tagged, 17 (42.5%) were recovered. This is considered an excellent recovery rate, since on some visits to the site as many as 130 *Forreria belcheri* were seen. All

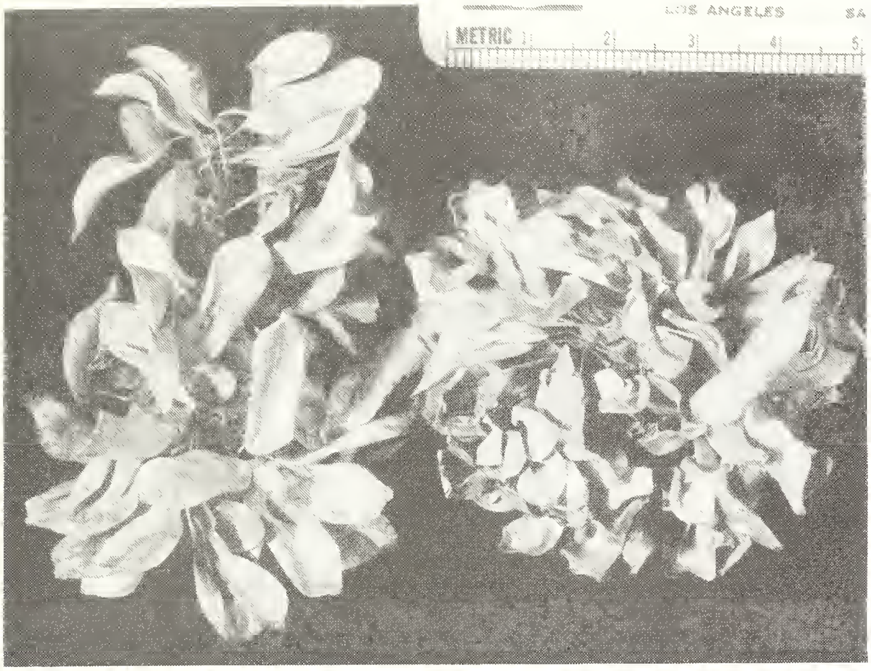

Figure 10. *Forreria belcheri* egg mass (SBMNH 25538). Photo: D. K. Mulliner.

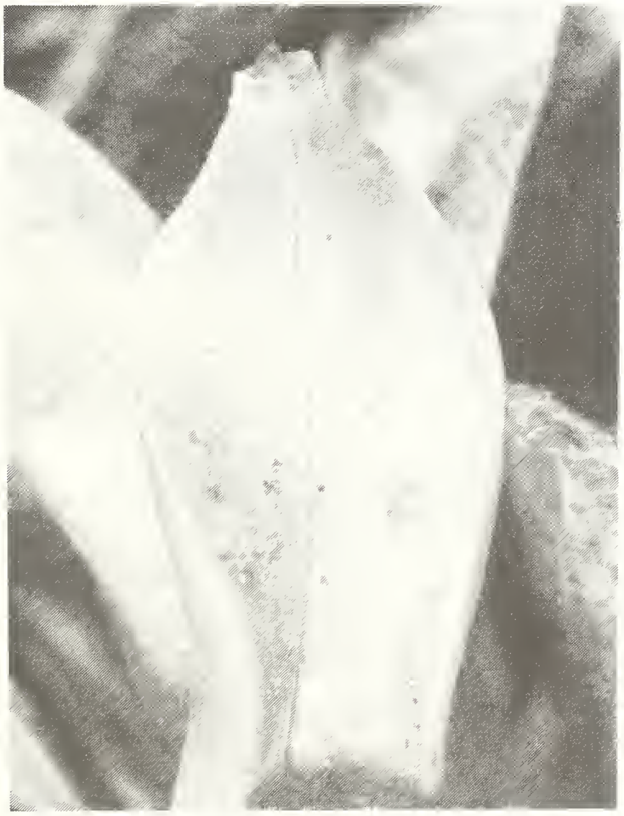

Figure 11. Side view of one of the ampulliform egg capsules from the egg mass shown in Figure 10. Photo: D. K. Mulliner.

recovered specimens showed a minor amount of lip growth, the largest being 27.0 mm. There was no correlation between growth and initial shell dimensions. The poor results may be attributed to the initial size of the tagged animals, all of which were adults or sub-adults. Despite considerable searching at the site and adjacent areas, no juveniles were ever found. This suggests that the juveniles are to be found in other habitats, perhaps in deeper water. No animals were observed laying eggs, suggesting perhaps that the divers were not present at the site during breeding season or that the egg laying and juvenile growth stages occur elsewhere. Of the seven visits to the site, before and during the "*Forreria* Project," one was in the month of June and the others either September or November. Should colonies be studied in the future, it would be wise to visit them monthly. Some animals had egg capsules on their dorsums, but these were the capsules of the predominant gastropod in the area, *Kelletia kelletii*.

The *F. belcheri* were seen feeding only on *Mytilus californianus*, even though there were other bivalves present in the area. They were never observed under the Dock; their selected site being approximately 3 m beyond the outermost edge of the Dock. Here they fed on the mussels which had sloughed off the outermost pilings into 8 m of water. The preferred area for the *F. belcheri* was at depths of 9-11 m. The numbers of *F. belcheri* found during the visits to the site varied considerably, suggesting perhaps a migratory pattern. This was reinforced by the indications of the great mobility exhibited by the animals, one tagged animal being found 61 m from its site. Other animals were seen at the end of very long trails (>9 m) which originated in deeper water. No *F. belcheri* were found during the last visit to the site. This may be a result of the diminished food supply and the great disturbance of the sea bottom at the site.

The study suggests a need to determine where and at what time the *F. belcheri* lay their eggs, the speed at which juveniles mature, and their life expectancy.

ACKNOWLEDGMENTS

The authors are very appreciative of the contributions of the other team members, Kim Hutsell, Larry Buck and Dave Mulliner, who did the bulk of the work on this project, *i.e.* diving, gathering animals, tagging, making measurements and doing field observations, recording data, and photographing the animals and site. We are indebted to Charles Waters for introducing the team members to this unique habitat and for alerting us to the planned destruction of the site. We thank Paul Scott of the Santa Barbara Museum of Natural History for allowing us use of the Museum facilities and for loan of the *Forreria belcheri* egg mass. Anthony D'Attilio kindly allowed us to use his radula drawing of *F. belcheri*. John Jackson and Charles Waters helped the project by providing photographs of the Old Navy Fuel Dock area, showing the area before and after the destruction of the Dock. Charles D'Asaro and Terrence Gosliner were very helpful to us in our pursuit of information on egg laying by *Forreria belcheri*.

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Table 1

"*Forreria* Project" Data

Data Collected: 11/18/92
Recovered Specimens :(1) 09/23/93
(2) 11/02/93
(3) 06/04/94
Final Visit to Site: 09/15/94

PROJECT TEAM MEMBERS:
Larry Buck
Carole Hertz
Jules Hertz
Kim Hutsell
Dave Mulliner

Forreria Tag No.	Length mm	Width mm	Weight gm	Aperture Color	Protoconch Damage	Overall Erosion	Other Damage	Remarks
1	135.9	75.5	220	0	0	0	0	
2 (3)	152.5 153.1	87.1	377	1+	1+	3+	2	Numerous sponge holes, a few barnacles, damage to dorsal spines New growth from notch: 0.59 mm
3	124.9	66.4	164	0	1+	0	0	A few barnacles
4 (1)	120.9 126.0	69.4	166	2+	2+	0	0	New growth from notch: 20.0 mm
5 (3)	149.4 148.2	83.5	360	4+	1+	2+	0	Very old specimen New growth from notch: 1.7 mm
6	128.6	70.9	200	1+	1+	0	1+	
7 (3)	129.5 126.1	74.5	198	Slt	0	0	1+	Spine damage New growth from notch: 2.5 mm
8 (1)	127.1 126.0	75.0	213	3+	3+	1+	3+	A few barnacles New growth from notch: 3.5 mm
9	141.9	76.6	255	1+	1+	Slt	1+	Spine damage
10 (1)	128.8 129.0	74.5	192	1+	1+	0	Slt	New growth from notch: 5.0 mm
11	127.2	74.8	203	4+	2+	Slt	1+	Spine damage
12 (3)	123.7 125.9	70.2	162	1+	1+	Slt	1+	Spine damage New growth from notch: 7.2 mm; tag barely attached by byssal threads from mussel
13	102.7	60.2	96	Slt	Slt	0	0	
14	116.6	69.2	153	0	Slt	0	0	
15	125.6	76.1	183	1+	0	0	0	
16	134.0	78.0	220	1+	Slt	0	Slt	
17	129.9	73.0	141	1+	1+	0	1+	Immature (thin) lip
18 (1)	162.1 155.0	88.8	375	4+	2+	Slt	1+	Spine damage New growth from notch: 3.0 mm

19 (3)	125.5 125.1	74.4	190	Slt	Slt	Slt	Slt	New growth from notch: 1.8 mm
20	130.4	68.8	160	1+	2+	Slt	0	A few barnacles
21 (3)	128.7 130.5	75.4	205	0	Slt	Slt	1+	Spine damage New growth from notch: 6.8 mm
22	145.1	83.5	279	3+	1+	2+	1+	
23 (1)	137.2 139.0	78.7	221	Slt	2+	2+	2+	Spine damage New growth from notch: 3.0 mm
24 (1)	124.2 127.5	72.1	199	0	1+	1+	1+	Spine damage, a few barnacles New growth from notch: 6.0 mm
25	135.8	84.0	284	1+	1+	Slt	2+	Broken siphon
26 (2)	133.2 133.6	76.4	240	Slt	3+	1+	1+	New growth from notch: 27.0 mm
27 (3)	125.1 152.1	80.0	248	Slt	Slt	Slt	Slt	Black lip and columella New growth from notch: 1.0 mm
28	139.0	82.7	255	1+	2+	Slt	1+	Spine damage
29	135.6	83.7	323	4+	3+	Slt	2+	Spine damage, broken siphon
30 (3)	126.5 124.4	73.3	186	4+	3+	4+	3+	Spine damage, previous siphons broken, black lip New growth from notch: 3.6 mm
31	125.2	74.4	199	Slt	Slt	Slt	1+	Spine damage
32	125.2	72.0	173	2+	Slt	0	Slt	
33	135.6	83.6	323	1+	1+	Slt	1+	Spine damage, black lip
34	128.2	80.0	229	Slt	2+	0	2+	
35 (1)	134.2 140.0	82.6	306	3+	1+	Slt	2+	Spine damage New growth from notch: 4.5 mm
36	135.4	82.0	274	2+	Slt	Slt	1+	Spine damage
37 (3)	113.1 136.6	66.4	129	0	1+	0	1+	Spine damage New growth from notch: 1.5 mm
38	123.6	66.6	160	0	Slt	Slt	Slt	A few barnacles
39	108.2	63.5	116	Slt	Slt	Slt	1+	Spine damage
40	145.0	84.2	274	2+	2+	1+	Slt	Black lip

GLYCYMERIS SEPTENTRIONALIS (MIDDENDORFF, 1849) (MOLLUSCA: BIVALVIA) IN THE GULF OF CALIFORNIA, MEXICO

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Dredging off Isla Smith (113° 34'W, 29° 6'N), Bahía de los Angeles, Baja California, Mexico, has produced several Californian species not previously known to exist in the Gulf of California. These include *Pteropurpura macroptera* (Deshayes, 1839) (Skoglund, 1983), *Ventricolaria fordi* (Yates, 1890) (Skoglund, 1988), *Iothia lindbergi* McLean, 1985 (Skoglund, 1989), *Chama arcana* Bernard, 1976 (Skoglund, 1991), *Pseudochama granti* Strong, 1934 (Hertz & Skoglund, 1992) and *Ophiodermella fancherae* Dall, 1903 (Skoglund, 1994). This paper adds an additional species to the list.

A single specimen of *Glycymeris septentrionalis* (Middendorff, 1849) (Figures 1 & 2) has been dredged off N.W. Isla Smith, in 120 to 170 m. This is the first record of this species in the Gulf of California, Mexico.

G. septentrionalis is a variable species with many synonyms which are discussed by Hertz (1994). The previously known distribution is

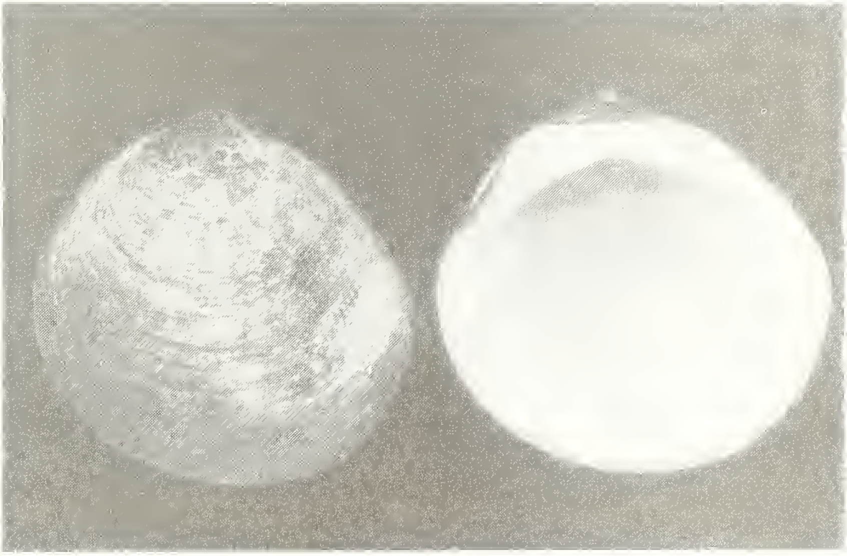

Figure 1. *Glycymeris septentrionalis* (Middendorff, 1849), exterior and interior views. Photo: D. K. Mulliner.

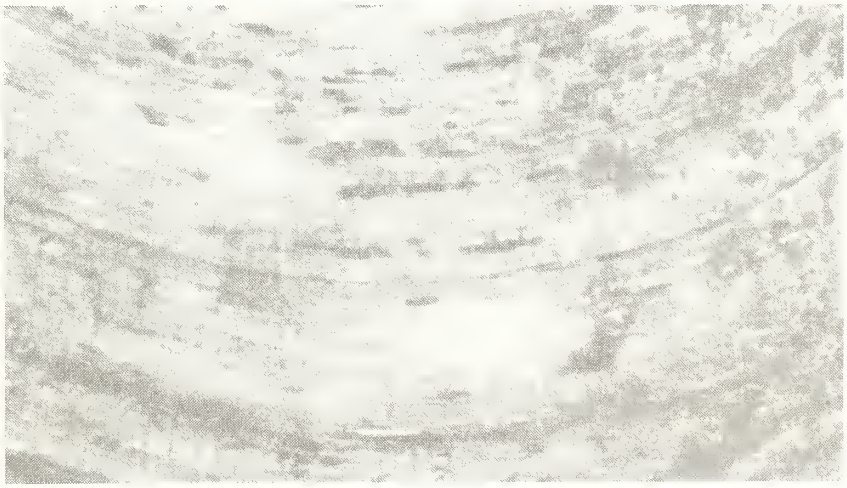

Figure 2. Detail of exterior sculpture of specimen shown in Figure 1. Photo: D. K. Mulliner.

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from the western Gulf of Alaska (56° N) to Rocas Alijos (25° N), an island off the west coast of Baja California Sur (Hertz, 1994).

My sincere thanks to Dr. Eugene V. Coan for the shell identification and to David K. Mulliner for the excellent photos.

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THE FESTIVUS

A publication of the San Diego Shell Club

Volume: XXVII June 8, 1995 Number: 6

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Room 104, Casa Del Prado, Balboa Park

PROGRAM

Exploring and Collecting in Chile

Ron McPeak, marine biologist, club member and award winning underwater photographer, will present a slide program on his recent trip to Chile, discussing the beauty of both its land and marine areas.

Shells of the month: South American shells
Meeting date: June 15, 1995

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CLUB NEWS

The Club Christmas Party

A date and place have been set for the Club's annual Christmas party. It will be held on the first Saturday in December (December 2nd) at the Sheraton Inn, San Diego Central (near Montgomery Field). Mark your calendars. Details later.

Additions to the Roster

Chadam, Maria T., 113 Carl's Way, Ithaca, NY 14850, (600) 272-0424.
Garrison, Susan, 1846 Hamilton Hwy., Adrian, MI 49221.

Additions to the Club Library

The Club has received the following **Records** and **Memoirs of the Australian Museum** for inclusion in the Club library.

Beu, A. G. & W. F. Ponder
1979. A revision of the species of *Bolma* Risso, 1826 (Gastropoda: Turbinidae). Records of the Australian Museum 32(1-3):1-68, 19 figs.
Brunckhorst, David J.
1993. The systematics and phylogeny of Phyllidiid nudibranchs (Doridoidea). *ibid*, Supplement 16:1-107,9 color pls., 33 figs.
Garrard, T.A.
1975. A revision of Australian Cancellariidae (Gastropoda: Mollusca). Records of the Australian Museum 30(1):1-62, 5 pls.
Hedley, Charles
1899a. The Mollusca of Funafuti , Part I--Gastropoda. Memoir 3(7):397-488.
1899b. *ibid.*(Supplement) 3(9):549-564.
1899c. *ibid*, Part II--Pelecypoda and Brachiopoda. 3(8):491-510.
1902. Scientific results of the trawling expedition of HMCS "Thetis", off the coast of New South Wales, Mollusca. Part I-- Brachiopoda and Pelecypoda. *ibid* 4:287-324.
1903. *ibid*. Mollusca. Part 11--Scaphopoda and Gastropoda. 4:327-402, 1 pl.
1907. Results of deep-sea investigation in the Tasman Sea. 3.--Mollusca from eighty fathoms off Narrabeen. Records of the Australian Museum 6(4):283-304, pls. 54-56.
1912. Descriptions of some new or noteworthy shells in the Australian Museum. *ibid*. 8(3):131-160, pls. 40-45.
Hedley, Charles & W. F. Petterd
1906. Mollusca from three hundred fathoms off Sydney. Records of the Australian Museum 6(3):211-225, pls. 37, 38.
Hedley, Charles & W. L. May
1908. Mollusca from one hundred fathoms seven miles east of Cape Pillar, Tasmania. *ibid*. 7(2):108-125, pls. 22-25.
Iredale, Tom & D. F. McMichael
1962. A reference list of the marine Mollusca of New South Wales. Memoir of the Australian Museum 11:1-109.
Marshall, B.A.
1983. A revision of the Recent Triphoridae of Southern Australia. Records of the Australian Museum, Supplement 2:1-119, 33 figs.
Morton, B.
1979. The biology and functional morphology of the coral-sand bivalve *Fimbria fimbriata* (Linnaeus, 1758). Records of the Australian Museum 32(11-13: 389-420, 21 figs.
Ponder, W. F. & E. K. Yoo
1976. A revision of the Australian and Tropical Indo-Pacific Tertiary and Recent species of Pisinna (=Estea) (Mollusca: Gastropoda: Rissoidae). *ibid*. 30(10):150-247, 19 figs.
1980. A review of the genera of the Cingulopsidae with a revision of the Australian and tropical Indo-Pacific species (Mollusca: Gastropoda: Prosobranchia). *ibid*. 33(1-3):1-88, 24 figs.
Warén, Anders & Michael R. Crossland
1991. Revision of *Hypermastus* Pilsbry, 1899 and *Turveria* Berry, 1956 (Gastropoda: Prosobranchia: Eulimidae), two genera parasitic on sand dollars. *ibid*. 43(1):85-1122, 13 figs.
Willan, R.C.
1993. Taxonomic revision of the family Psammobiidae (Bivalvia: Tellinoidea) in the Australian and New Zealand region. *ibid*. Supplement 18:1-132, 416 figs.
Wilson, B. R.
1979. A revision of Queensland Lithophagine mussels (Bivalvia, Mytilidae, Lithophaginae). *ibid*. 32(11-13):435-489, 18 figs.
Yonge, C. M.
1981. Functional morphology and evolution in the Tridacnidae (Mollusca: Bivalvia: Cardiacea). *ibid*. 33(17-19):735-777, 29 figs.
Yoo, E. K.
1994. Early Carboniferous Gastropoda from the Tamworth Belt, New South Wales. *ibid*. 46(1):63-120, 23 pls.

THE EPITONIIDAE OF SAN FELIPE AND ENVIRONS, GOLFO DE CALIFORNIA, FROM THE GEMMELL COLLECTION (1965-1976)

JOYCE GEMMELL
150 South Anza, #47C, El Cajon, California 92020, USA

CAROLE M. HERTZ[1] & BARBARA W. MYERS[2]
Associates, Santa Barbara Museum of Natural History, 2559 Puesta del Sol Road,
Santa Barbara, California 93105, USA

Abstract: Twelve species of Epitoniidae in four genera are identified in the Gemmell collection from the San Felipe area three of which - [*Asperiscala obtusa* (Sowerby, 1844), *Hirtoscala replicata* (Sowerby, 1844), and *Opalia crystallina* (Carpenter, 1864)] - have not been previously reported at San Felipe.

The Epitoniidae have been studied by Helen DuShane. Her major works include the epitoniids of the eastern Pacific and the Panamic Province (DuShane, 1962, 1974, 1979b, 1985). These works, with excellent illustrations of type material as well as original descriptions and her expanded diagnoses, greatly facilitated our identifications of the epitoniid specimens in the Gemmell collection. We follow the generic placements of the epitoniids in DuShane (1979b and 1985).

The Gemmell specimens were compared with the Epitoniidae material in the Carol Skoglund collection and the identifications of the Gemmell drawings were confirmed by Helen DuShane.

Following is an illustrated listing of the twelve species, collected by Gemmell, arranged alphabetically by genus. Listings include synonymy, where appropriate, occasional remarks and distributional information. All species are drawn by Gemmell from material in her collection studied for this paper. An asterisk next to a species name indicates an extension of the known distribution. All specimens are currently housed in the San Diego Natural History Museum (in the office of the Department of Entomology). For maps of the areas discussed, see Gemmell, Myers & Hertz (1987).

Family EPITONIIDAE

Genus *Asperiscala* deBoury, 1909

Asperiscala acapulcana Dall, 1917

(Figure 1)

Proceedings of the United States National Museum 53:475. Fig'd: Keen (1971:425, fig. 611 [right, holotype]); DuShane (1974, figs. 9, 10 [holotype]).

Synonyms: *A. xantusi* Dall, 1917:475; *A. keratium* Dall, 1919:340; *Epitonium slevini* Strong & Hertlein, 1939:193; *E. strongi* Bartsch, 1928:71. [Synonyms fig'd: DuShane (1974, figs. 1-4, 7)].

Material: 1 spec., 4.4 mm L, Playa Alicia, San Felipe, in grunge.

1 spec., 8.5 mm L, Pete's Camp, 12.9 km N of

---

[1] Mailing address: 3883 Mt. Blackburn Ave., San Diego, CA 92111, USA

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San Felipe, in drift.

Distribution: DuShane & Sphon (1968:240) listed the species at San Luis Gonzaga. DuShane (1974) listed the distribution from Bahía Magdalena throughout the Gulf, S to Ecuador (one record from Consag Rock, San Felipe in DuShane collection).

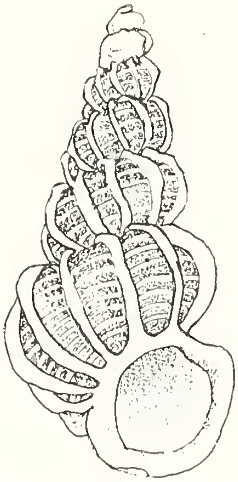

Figure 1. *Asperiscala acapulcana* Dall, 1917. Length: 4.4 mm.

Asperiscala emydonesa Dall, 1917
(Figure 2)

Proceedings of the United States National Museum 53:476. Fig'd: Keen (1971:424, fig. 616 (right, [holotype]); DuShane (1974, fig. 33 [holotype]).

Synonyms: *A. imperforata* Dall, 1917; *A. manzanillense* Hertlein & Strong, 1951. [Synonyms fig'd: DuShane (1974, figs. 31 & 32)].

Material: 3 spec., 1.4-1.8 mm L, Puertecitos, in grunge, February 1971.
1 spec., 3.0 mm L, Playa Alicia, San Felipe, in grunge.
1 spec., 2.0 mm L, Bahía Willard, San Luis Gonzaga, 1969.
4 spec., 1.6-2.1 mm L, dredged by fishing boat **Chamizal II**, W of Isla Salvatierra, 0.8 km offshore (29°57'48"N, 114°28'W) in 26 m in sand, 9-10 July 1969.

Distribution: Dall described the species from the Galápagos in 72 m, and the synonym, *A. imperforata*, from off La Paz, Golfo de California in 47 m. *Asperiscala manzanillense* was described by Hertlein and Strong from Manzanillo, Colima, México. DuShane (1974:14) lists the species throughout the Golfo de California south to the Islas Galápagos.

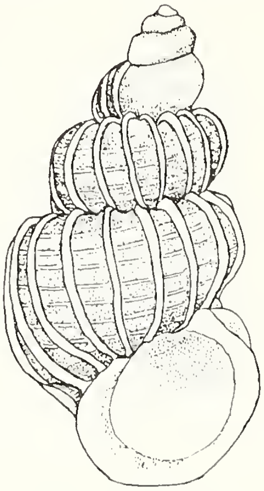

Figure 2. *Asperiscala emydonesa* Dall, 1917. Length: 2.0 mm.

**Asperiscala obtusa* (Sowerby, 1844)
(Figure 3)

Proceedings of the Zoological Society of London, pt. 12:29. Fig'd: Keen (1971, fig. 653, left [syntype]); DuShane (1974, fig. 45 [syntypes]).

Synonyms: *Scalaria tiara* Carpenter, 1856:24; *Epitonium roberti* Dall, 1917. [Synonyms fig'd: DuShane (1974, figs. 43 & 44)].

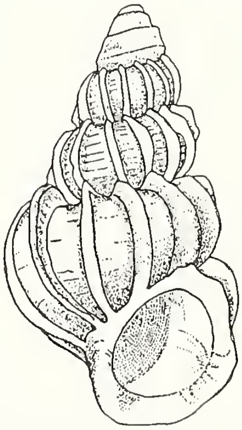

Figure 3. *Asperiscala obtusa* (Sowerby, 1844). Length: 2.7 mm.

Material: 3 spec., 2.7-4.2 mm L (with operculum), Playa Alicia, San Felipe, in grunge, intertidal.

Remarks: See DuShane (1974:23) for a discussion of the synonymy of this species. The Gemmell specimens are juveniles with 3 nuclear whorls and 3 teleoconch whorls. DuShane (1974:22) noted the species with 8-9 teleoconch whorls, 11-25 mm long.

Distribution: DuShane (1974:23) listed the Golfo de California, and the west Mexican coast to Colombia. However, this is the first record of the species in the northern Gulf at San Felipe.

Asperiscala walkerianum (Hertlein & Strong, 1951)
(Figure 4)

Zoologica 36(5):88-89, pl. 3, fig. 12. Also fig'd: DuShane (1974, fig. 17 [holotype]).

Material: 1 spec., 5.2 mm L, San Felipe, in drift.
9 spec., 4.4-8.8 mm L, Pete's Camp, 12.9 km N of San Felipe, in drift.
2 spec., 2.8 & 4.0 mm L, Dredged by fishing boat **Chamizal I** off Pta. Estrella, San Felipe [30°51'12"N to 30°41'N and 114°32'W to 114°48'W] approx. 6 km offshore in 9-18 m in seastar stomachs.
4 spec., 4.5-5.7 mm L (broken apertures), Dredged by fishing boat **Chamizal II**, W of Isla Salvatierra, (29°57'48"N, 114°28'W) 0.8 km offshore in 26 m in sand, 9-10 July 1969.

Remarks: See Gemmell, Hertz & Myers (1980) for mention of specimens from seastar stomachs.

Distribution: DuShane (1974:26) listed the species from San Felipe, Golfo de California, along W coast of México to Nicaragua.

Genus *Hirtoscala* Monterosato, 1890

Hirtoscala reflexa (Carpenter, 1856)
(Figure 5)

Proceedings of the Zoological Society of London for 1855:235. Fig'd: Palmer (1963, pl. 63, figs. 5,6 [holotype]); DuShane (1974, fig. 94 [holotype]).

Material: 2 spec., 6.4 & 10.0 mm L, Playa Alicia, San Felipe in fine sand among rocks, -1.5 to -1.8 m (-5 to -6 ft) tide, March 14-16, 1976.
7 spec., 5.9-19.7 mm L, Pete's Camp, 12.9 km N of San Felipe, in drift.

Distribution: DuShane & Brennan (1969:358) listed the species from dredging off Consag Rock, San Felipe. DuShane (1974:43) listed Bahía Magdalena, Baja California, throughout the Golfo de California and S to Nicaragua. Shasky (1984) extended the distribution S to Manabí Province, Ecuador.

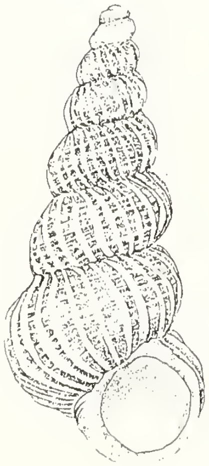

Figure 4. *Asperiscala walkerianum* (Hertlein & Strong, 1951). Length: 5.3 mm.

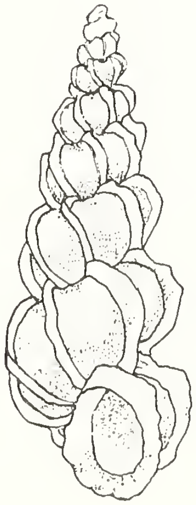

Figure 5. *Hirtoscala reflexa* (Carpenter, 1856). Length: 19.7 mm.

**Hirtoscala replicata* (Sowerby, 1844)

(Figure 6)

Proceedings of the Zoological Society of London 12:11. Fig'd: Keen (1971, fig. 637 [syntypes]); DuShane (1974, fig. 99 [lectotype]).

Synonyms: *Epitonium bialatum* Dall, 1917:485; *E. wurtsbaughi* Strong & Hertlein, 1939:193; and *E. oerstedianum* Hertlein & Strong, 1951:89. [Synonyms fig'd: DuShane (1974, figs. 95, 97, 98)].

Material: 7 spec., 3.8-18.3 mm L, Puertecitos, in drift in east side of Bay, March 1967.

1 spec., 4.0 mm L, Ensenada Blanca, San Felipe, June 1968.

1 spec., 5.5 mm L, Dredged by fishing boat **Chamizal II**, W of Isla Salvatierra, (29°57'48"N, 114°28'W), 0.8 km offshore in 26 m in sand, 9-10 July 1969.

Distribution: DuShane (1974:44) listed the species from the Golfo de California (Guaymas, Bahía Escondido, and Bahía Santa Inez) S to Panamá and the Islas Galápagos. Cosel (1984) included Isla Gorgona, Colombia, and Shasky (1984) included Isla del Coco, Costa Rica. This is the first report of the species at San Felipe and Puertecitos in the northern Golfo de California.

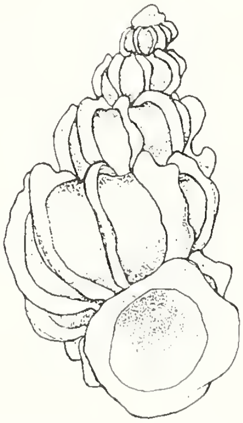

Figure 6. *Hirtoscala replicata* (Sowerby, 1844). Length: 7.5 mm.

Genus *Nitidiscala* de Boury, 1908

Nitidiscala arcana (DuShane, 1979)

(Figure 7)

Veliger 21(3): 379-380, fig. 1.

Material: 12 spec., 3.8-11.7 mm L, dredged by fishing boat **Chamizal II**, W of Isla Salvatierra, 0.8 km offshore (29°57'48"N, 114°28'W) in sand in 26 m, 9-10 July, 1969.

189 spec., 3.6-14.7 mm L, Pete's Camp, 12.9 km N of San Felipe, November 1970.

16 spec., 3.6-11.4 mm L, Santa Maria Lagoon, alive in drift on tide flat, October 1973.

1 spec., 4.2 mm L, Playa Alicia, in fine sand among rocks at -1.5 to -1.8 m tide.

1 spec., 8.4 mm L, San Felipe.

Remarks: Dall stated that *Epitonium (Nitidiscala) barbarinum* had a range from San Diego to Panamá. DuShane (1979:379-380) considered *E. (N.) barbarinum* to be a synonym of the east coast species *E. angulatum* Say, 1830, leaving the northern Gulf of California species without a name. Gemmell, in 1968 noted that this species was "very common."

Distribution: DuShane (1979) restricted the species to the W side of the Gulf from San Felipe to Puertecitos and on the E side from Puerto Peñasco S to Cabo Tepoca, Sonora.

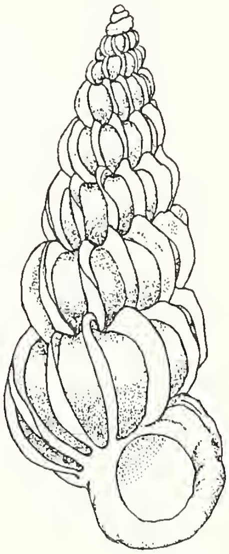

Figure 7. *Nitidiscala arcana* (DuShane, 1979). Length: 11.6 mm.

Nitidiscala durhamianum (Hertlein & Strong, 1951)
(Figure 8)

Zoologica 36(5):89-90, pl. 3, fig. 9. Fig'd also: DuShane (1974, fig. 104 [holotype]).

Material: 2 spec., 3.3-6.0 mm L, Ensenada Blanca, San Felipe.
1 spec., 2.7 mm L, dredged by fishing boat **Chamizal I** off Consag Rock, San Felipe, 3 km from Rock, in sand in 22 m [31°06'N, 114°30'05"W] on white hydroid, 28 June 1968.
7 spec., 5.0-9.5 mm L, San Felipe, in drift.
5 spec., 7.6-11.1 mm L, Pete's Camp, 12.9 km N of San Felipe.
4 spec., 2.5-6.0 mm L (largest spec. collected live), dredged by fishing boat **Chamizal II** W of Isla Salvatierra, (29°57'48"N, 114°28'W), 0.8 km offshore in 26 m, in sand, 9-10 July 1969.
7 spec., 6.5-7.7 mm L (protoconchs broken), Bahía San Felipe, in drift, 1968.
1 spec., 3.6 mm L, 8 km (5 mi) S of Puertecitos, 1975.

Remarks: The number of costae on the Gemmell specimens numbered up to 22 rather than the 16 noted in the original description, but otherwise is within the parameters of this species.

Distribution: DuShane & Brennan (1969:358) listed the species at Consag Rock. DuShane (1974:32) listed the northern Golfo de California (at Pta. Peñasco) and the type locality at Nicaragua.

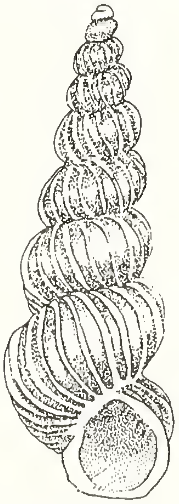

Figure 8. *Nitidiscala durhamianum* (Hertlein & Strong, 1951). Length: 5.3 mm.

Nitidiscala hindsii (Carpenter, 1856)
(Figure 9)

Proceedings of the Zoological Society of London 165. Fig'd: Keen (1971:432, fig. 652 [syntypes]); DuShane (1974, fig. 81 [syntypes]).

Synonyms: *Epitonium apiculatum* Dall, 1917 [not Dall, 1889]; *E. compradora, E. cylindricum, E. musidora*, and *E. pazianum* all of Dall, 1917 and *E. bakhanstranum* Keen, 1964. [Synonyms fig'd: DuShane, (1974, figs. 79, 80, 83, 84, 87, 88)].

Material: 28 spec., 3.4-15.5 mm L, San Felipe, common in drift.
15 spec., 1.3-15.0 mm L, Pete's Camp, 12.9 km of San Felipe, in drift.
8 spec., 1.2-8.6 mm L, Puertecitos.
3 spec., 2.7-5.0 mm L, dredged by the fishing boat **Chamizal II**, W of Isla Salvatierra, (29°57'48"N, 114°28'W), 0.8 km offshore in sand in 26 m, 9-10 July 1969.

Remarks: An explanation of the taxonomic history of this species can be found in DuShane (1974).

Distribution: DuShane & Brennan (1969:358) listed the species (as *E.(N). bakhanstranum*) from Consag Rock, San Felipe. DuShane (1974) listed the distribution as Punta Abreojos on the outer coast of Baja California through the Gulf to Panamá and Perú. DuShane (1979) listed the species from Forrester Island, Alaska to Perú.

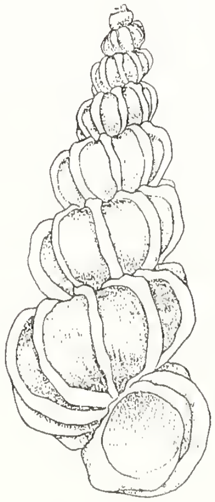

Figure 9. *Nitidiscala hindsii* (Carpenter, 1856). Length: 13.0 mm.

Genus *Opalia* H. & A. Adams, 1853

**Opalia crystallina* (Carpenter, 1864)
(Figure 10)

Annals and Magazine of Natural History 3(13):477. Fig'd: DuShane (1974, fig. 142 [holotype]).

Synonym: *Epitonium (Nodiscala) espiritum* Baker, Hanna & Strong, 1930. [Synonym fig'd: DuShane (1974, fig. 140)].

Material: 2 spec., 7.0 & 8.5 mm L, N of Pta. San Felipe, in drift.

Distribution: DuShane (1974) listed the Golfo de California (as far N as Puertecitos) S to Chiapas, México. This is the first record of the species at San Felipe.

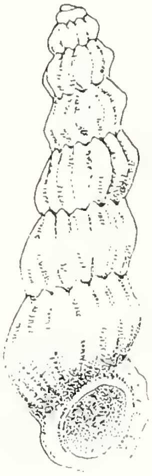

Figure 10. *Opalia crystallina* (Carpenter, 1864). Length: 8.5 mm.

Opalia funiculata (Carpenter, 1857)
(Figure 11)

British Association for the Advancement of Science, Report 26 (for 1856):447. Fig'd: Keen (1971, fig. 680 [3 photos, syntypes]); DuShane (1974, fig. 125 [lectotype]).

Synonyms: *Dentiscala crenimarginata* Dall, 1917:473; *D. nesiotica* Dall, 1917:473; *Opalia (?crenatoides, var.) insculpta* Carpenter, 1864 [Synonyms fig'd: DuShane (1974, figs. 122-124)].

Material: 9 spec., 5.9-17.3 mm L, (one live collected) Pta. San Felipe at Campo Uno, on and under rocks, June 1969.

4 spec., 5.8-13.6 mm L, 10 km S of abandoned sulphur mine (45 km S of San Felipe), on -1.5 m tide, February 1969.

5 spec., 6.9-14.2 mm L, San Felipe.

Remarks: For discussion of the synonymy of this species, see DuShane (1979:122-124).

Distribution: DuShane (1979) listed the continuous distribution from Refugio Beach, Santa Barbara County, California throughout the Gulf to the Islas Galápagos, Ecuador and Tumbes Province, Perú.

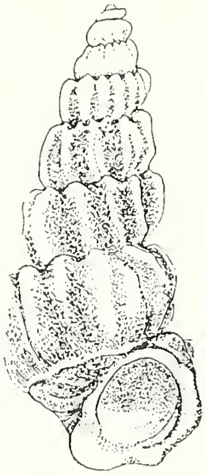

Figure 11. *Opalia funiculata* (Carpenter, 1857). Length: 17.0 mm.

Opalia sanjuanensis (Lowe, 1932)
(Figure 12)

The Nautilus 45(4):115, pl. 9, fig. 4. Fig'd also:DuShane (1974, fig. 136 [holotype]).

Synonym: *O. clarki* (Olsson & M. Smith, 1951) [Synonym fig'd: DuShane (1974, fig. 137)].

Material: 7 spec., 9.1-12.4 mm L, San Felipe to Pete's Camp, 12.9 km N of San Felipe, in drift, 1967-1968.

2 spec., 5.2 & 10.4 mm L, Playa Laguna, San Felipe, 28 November 1971.

Remarks: The outer apertural lips of the Gemmell specimens are not reflected, most likely because they are worn. They are, however, thickened and show punctations.

Distribution: DuShane (1974) listed the species from

Agua Chale (S of San Felipe) on the W side of the upper Golfo de California to Santa Rosalía, Baja California Sur, Manzanillo, Colima, México to Playa Venado, Panamá.

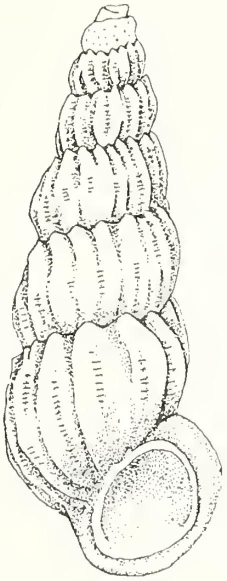

Figure 12. *Opalia sanjuanensis* (Lowe, 1932). Length: 10.3 mm.

ACKNOWLEDGMENTS

Sally Shelton Director of Collections and Conservation, San Diego Natural History Museum, generously provided work space for us in her office and the Museum gave use of its facilities and access to the scientific library. Carol Skoglund kindly made her collection available for study and helped with identifications. Helen DuShane examined the Gemmell drawings and confirmed our identifications. We thank them all for their help.

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SINISTRAL *GRANULINA MARGARITULA* (CARPENTER, 1857) FOUND (GASTROPODA: MARGINELLIDAE)

CAROL SKOGLUND[1]

Associate, Santa Barbara Museum of Natural History, 2559 Puesta del Sol Road,
Santa Barbara, California 93105, USA

Sowerby (1846) first reported a sinistral shell within the Marginellidae. The phenomenon has been reported many times over the years for different species within the family. A single record of a sinistral *Granulina margaritula* (Carpenter, 1857) [as *Cypraeolina pyriformis* (Carpenter)] occurs in the literature (Coovert & Lee, 1989). This one shell is in the collection of the San Diego Natural History Museum and was collected "locally" by C. E. White (Chace, 1957).

This spring we went back to Puerto Lobos, Cabo Tepoca, Sonora, Mexico, to see what had happened to the shell populations since my 1974 thesis. The trip wasn't so much for collecting as for looking. It wasn't until we returned to Phoenix and a microscope that I found that one of the four tiny *Granulina margaritula* (Figure 1) taken from the underside of a rock near the low tide line was sinistral. This is the first sinistral shell occurring in a normally dextral family I have ever found.

My thanks to David K. Mulliner for the excellent photo.

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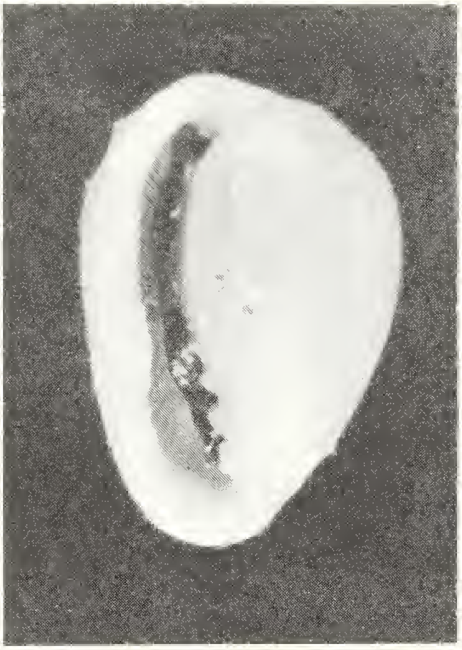

Figure 1. *Granulina margaritula*, sinistral specimen approximately 2 mm long, collected intertidally at Puerto Lobos, Cabo Tepoca, Sonora, Mexico. Leg. C. Skoglund, April 1994. Photo: D. K. Mulliner.

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THE FESTIVUS

A publication of the San Diego Shell Club

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PROGRAM

Fossil Mollusks of Southern California

Lindsey Groves, of the Malacology Section of the Los Angeles County Museum of Natural History, will present this slide program, with display. Lindsey is especially interested in the fossil cypraeids and ovulids.

and

John Decker Forest, 1995 Club Science Fair Winner, will present an overview of his winning project.

Shells of the month: Southern California fossil shells
Meeting date: July 20, 1995

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CLUB NEWS

From the Minutes
San Diego Shell Club Meeting - June 15, 1995

President Kay Klaus called the meeting to order at 7:40 p.m. Jules Hertz shared selections from the latest editions of **The Nautilus, Apex** and **The Veliger** and it was announced that two new additions to the Club library are Finet's 1994 **The Marine Mollusks of the Galapagos Islands: a Documented faunal List** and Houart's 1994 **Illustrated Catalogue of Recent Species of Muricidae Named since 1971**.

It was announced that the Botanical Garden Foundation has worked to upgrade security in the Park, especially in the evenings.

The upcoming COA convention was discussed with a request for additional volunteers to assist with the auction and other events.

Kim Hutsell introduced the speaker for the evening, Ron McPeak. Ron gave a very fascinating presentation of his trips to Chile. Most of the slides shown were of the central region of the country. Whereas the northern portion of the country is without plant life, the central and southern regions are rich with beautiful landscapes. Ron's slides showed the great, huge kelp forests and the shells and other animal life of those waters.

Rick Negus won the door prize for the evening and the cookies were brought by Margaret Mulliner and Kim and Linda Hutsell.

The meeting was adjourned to allow time to view the collection of shells from Chile brought by Ron and for socializing and refreshments.

Silvana Vollero

Additions and Changes to the Roster

New Members

Brewster, Brian S., 340 Quince Pl., Chula Vista, CA 91011-5522, (619) 425-0406

Buys, Jan-Paul, Tasmanstraat 144, 2518 VS Den Haag, The Netherlands, 31-70-3600434

Joffee, Anne, 1157 Periwinkle Way, Sanibel, FL33957, (813) 472-6691

Lewis, Judy, 2117 Via Estrada, Carrollton, TX 75006, (214) 416-4712

Pacific Northwest Shell Club, Inc., 2405 NE 279 St., Ridgefield, WA 98642

Change of Address

Vollero, Silvana & Bob Petroski, 5613 Carnegie St., San Diego, CA 92122

A Dues Raise for 1996

Because the postage rates have risen, as well as the increased costs of paper for printing **The Festivus**, the Club has been forced to raise the dues for the calendar year 1996. Rates for domestic membership will be increased from the current $12.00 to $15.00 and overseas (surface mail) membership will be raised from the current $15.00 to $18.00. Overseas (air mail) rates will remain at the current $30.00. Rates for 1995 continue as published.

Club/COA T-shirts and Sweatshirts Still Available

For those members and friends, both here and abroad, the Club announces that there are still some COA/ Club t-shirts and sweatshirts available. The shirts are of first quality with a superb design featuring four larger than life-size California shells -- an abalone, a cowry, a murex and a pecten.

The prices, while shirts last, remain the same: T-shirts at $15 ($17 for XXL) and sweatshirts at $25 ($27 for XXL). Please add $2.50 for domestic and overseas [surface] t-shirt orders and $3 [domestic] and $3.50 overseas [surface] for sweatshirt orders. Make checks payable to the San Diego Shell Club in care of 3883 Mt. Blackburn Ave., San Diego, CA 92111, USA.

COA 1995

The recent COA meeting was a huge success [report will be in the August issue of **The Festivus**] due in large part to the efforts of the many local San Diego Shell Club members who worked hard both in the planning and in assisting at the convention. They are listed here in alphabetical order.

Hugh & Marge Bradner, Larry & Lauren Buck, Larry Catarius, Jules & Carole Hertz, Kim & Linda Hutsell, John & Ellen Jackson, Kay & Del Klaus, Dave & Margaret Mulliner, Barbara Myers, Don & Jeanne Pisor, Stan & Mary Regula, Chuck & Jessica Reitz, Cindy Reynolds, Wally Robertson, Bill Romer, Bill & Nancy Schneider, Don Shasky and Ginny Ward.

A MILLION THANK YOUS !!

A NOTE ON THE MURICID GASTROPOD *MURICODRUPA JACOBSONI* IN THE PALAU ISLANDS

GEERAT J. VERMEIJ

Department of Geology, University of California at Davis, Davis, California 95616, USA

ROY K. KROPP

Batelle Ocean Sciences, 397 Washington Street, Duxbury, Massachusetts 02332, USA

Muricodrupa jacobsoni Emerson & D'Attilio, 1981, is a rare sublittoral muricid gastropod with a tropical western Pacific distribution. It has previously been collected in Fiji (the type locality), the Solomon and Bismarck Islands, and the Swain Reefs in Queensland, Australia (Emerson & D'Attilio, 1981; Wilson, 1994). Here we report a significant range extension to the Palau Islands, and provide the first observation of feeding in this species.

One of us (RKK) collected an adult (37.7 mm long)individual of *M. jacobsoni* on 9 July 1984 at a depth of 20 to 25 feet on *Halimeda* sand near the drop-off on Augulpelu Reef in the Palau Islands (Figure 1). The shell is conserved in the Vermeij collection.

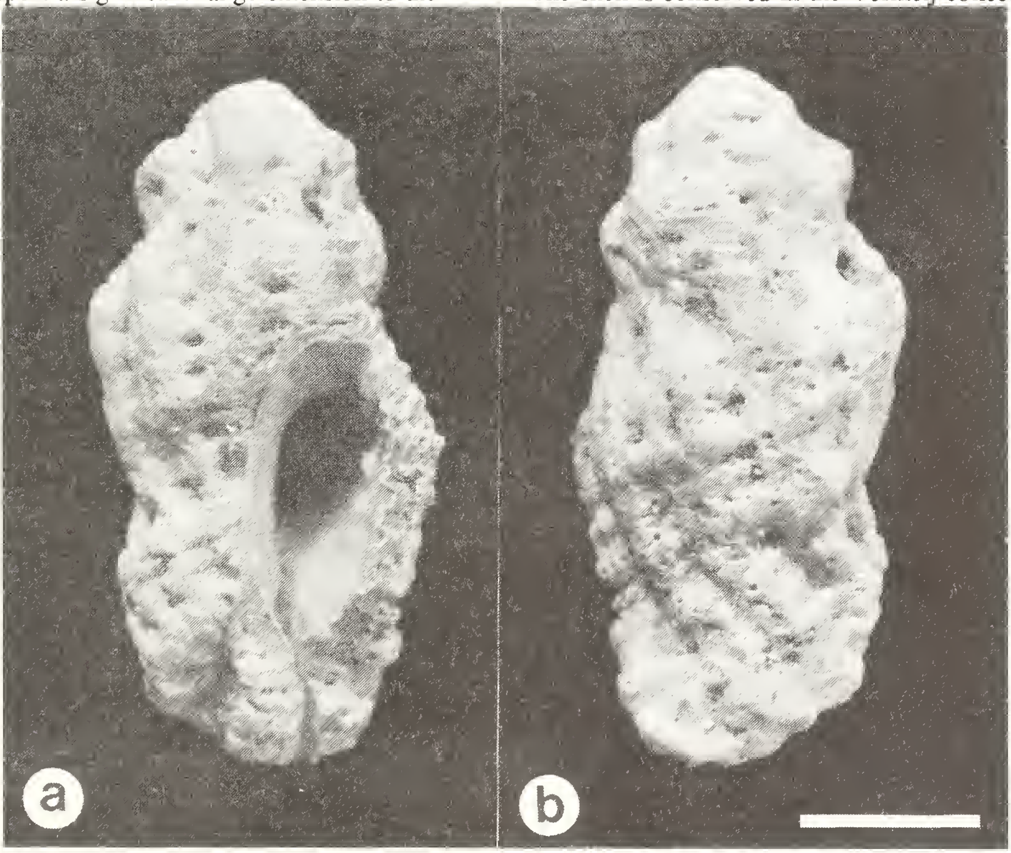

Figure 1. *Muricodrupa jacobsoni* Emerson & D'Attilio, 1981, Augulpelu Reef, Palau Islands, ventral (a) and dorsal (b) views. Scale bar, 1 cm.

The snail was caught in the act of drilling a 43.8 mm long adult individual of the cerithiid gastropod *Rhinoclavis sinensis* (Gmelin, 1791). The drill-hole, located on the dorsal surface of the antepenultimate whorl, had extended into a chamber excavated into the shell by a clionid sponge, but had not breached the full thickness of the shell wall. This single feeding observation accords well with previous statements about the diet of species of *Muricodrupa*. Taylor (1976, 1984) reports that *M. fenestrata* (Blainville, 1832) feeds on gastropods and on the eggs of species of *Nerita*, whereas *M. fiscella* (Gemlin, 1791) (as *M. funiculus*) eats other gastropods. All six food items recorded by one of us (GJV) for *M. fenestrata* at Majuro (Marshall Islands) in 1978 and at two sites in eastern Indonesia (in the Kei Islands and at Kinabohutan Island, northeast of Sulawesi) in 1979, were gastropods of the genera *Nerita* and *Planaxis*, which live with this predatory species in the upper intertidal zone. In short, the limited evidence indicates that species of *Muricodrupa* have a diet consisting chiefly of other gastropods.

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IN MEMORIAM

Walter E. Sage III

Kay Cunningham Vaught

It is with deep sadness that we report the passing of two friends of Malacology, fellow shell collectors and members of the San Diego Shell Club.

Walter was a guiding light of the Louisville Shell Club, indispensible member and treasurer of the Conchologists of America and Collection Manager in the Department of Living Invertebrates of the American Museum of Natural History.

Kay was a longtime collector specializing in the Muricidae who was responsible for the valuable work, **A Classification of the Living Mollusca** published in 1989.

We are all the poorer for their passing.

OBSERVATIONS ON THE BEHAVIOR OF SOME COSTA RICAN OLIVIDAE

GEORGE METZ

121 Wild Horse Valley Drive, Novato, California 94947, USA

The family Olividae is a popular group because its species have a polished exterior and are commonly found in shallow water. Discovering the trails of *Oliva sayana* Ravenel, 1834, at low tide on Galveston Island was one of my earliest introductions to shell collecting. At extreme low tides, a plowed furrow in the sand would meander along and end in a hump. Exposing that hump would reveal a beautiful shell.

A recent trip to Costa Rica brought back those early memories. Along the western beaches of Costa Rica from Playa Hermosa in the north to Playa Manuel Antonio in the south, the waves break with some force on a fairly steep beach. The sand varies from the typical coarse white in some areas to a black fine lava type in others. With the breaking surf and fine sand it did not look like a good habitat for shells. Never-the-less, beachcombing is an interesting form of exercise and sightseeing and these excursions revealed hundreds of little furrows at the upper edge of the surf line. Examination of these furrows revealed hundreds of *Olivella semistriata* (Gray, 1839) (Figure 1). Further explorations lower in the wave zone revealed a larger olive, an *Agaronia* species. These were much larger and less numerous than the olivellas. Subsequent identification revealed this species to be *Agaronia propatula* Conrad, 1849 (Figure 2). Both species had various color forms including the typical blue-gray forms, a white, a beautiful golden form and forms

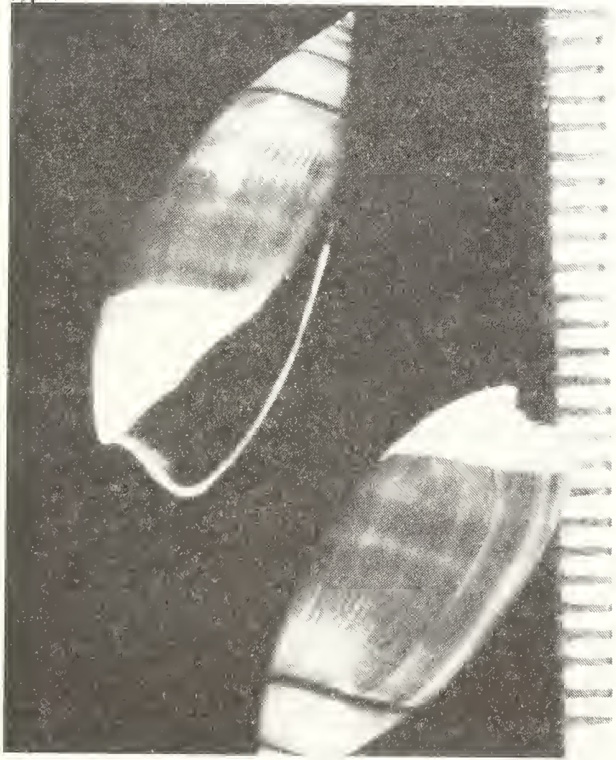

Figure 1. Two specimens of *Olivella semistriata* from Costa Rica.

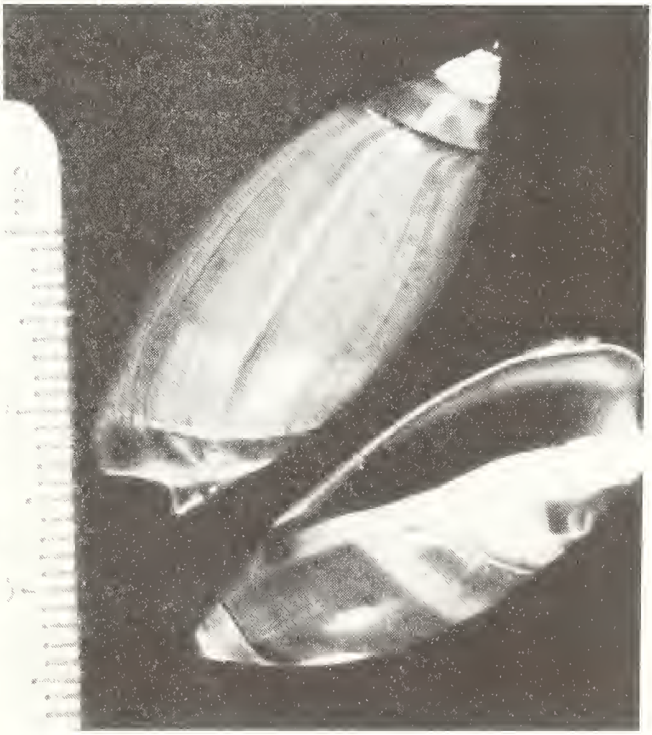

Figure 2. Two specimens of *Agaronia propatula* from Costa Rica.

intermediate to these.

Repeated observations revealed that the *Olivella* were always present at the top of the tide line and not exposed only during low tide. During rising tides they would catch incoming waves in order to follow the top of the tideline where they would burrow in to keep from being washed back to deeper water. The reverse activity would occur during outgoing tides. At the top of the tide line, where only occasional waves would reach, there would be the typical "trails" (Figure 3) but further down, in the areas more frequently bathed by each wave, the *Olivella* would position themselves by backing into the sand with just their tentacles exposed (Figure 4). There would be beds of them in this position, looking almost like an exotic flower garden.

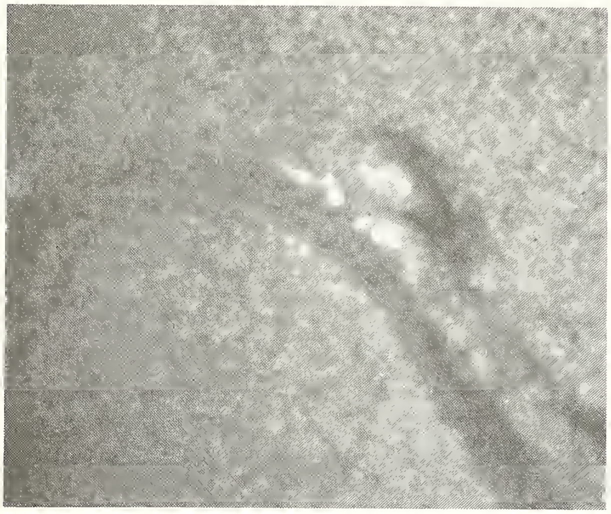

Figure 3. *Olivella semistriata* tracking in the sand.

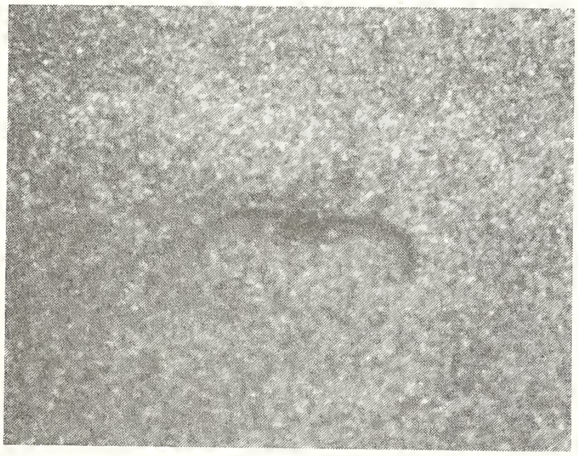

Figure 4. *O. semistriata* specimen in sand with tentacles exposed.

As I collected *Agaronia,* I often found them feeding on olivellas, confirming the observations of A.Lopez *et al.* (1988) who reported that *Olivella semistriata* is a common prey item for species of *Agaronia*. All of the *Agaronia* observed were plowing through the sand apparently hunting the *O. semistriata* (Figure 5). The prey of olivellas has been reported to include bivalves, copepods, amphipods, scaphopods and forams (Greifeneder, 1981). *O. semistriata was* burrowing through the upper tide line actively seeking some prey item, while the *A. propatula*, in turn, were seeking the *Olivella semistriata*.

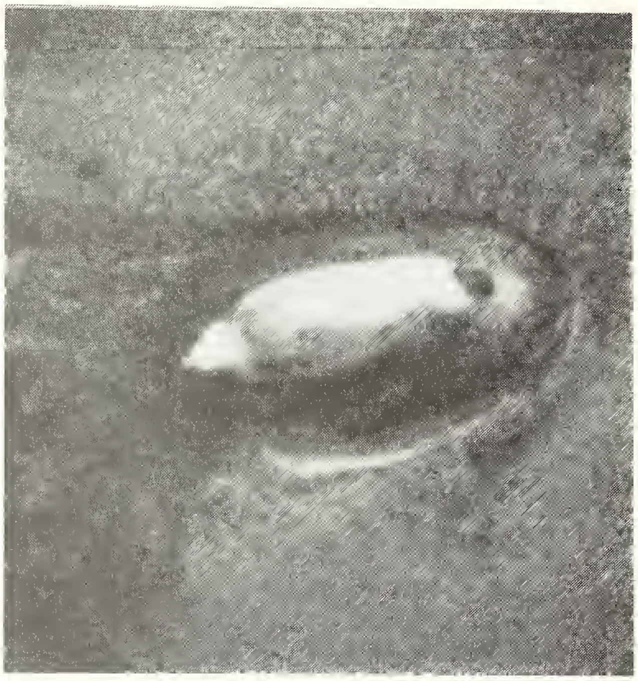

Figure 5. *Agaronia propatula* tracking in the sand.

A more interesting observation was the position of the olivellas backed into the sand with tentacles outstretched (Figure 4) as if waiting for something, such as copepods, forams or other detritus, to be washed in on the next wave.

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RANGE EXTENSION FOR *THAIS MELONES* (DUCLOS, 1832)

JULES HERTZ[1]

Associate, Santa Barbara Museum of Natural History
2559 Puesta del Sol Road, Santa Barbara, California 93105, USA

Recently, Carol and Paul Skoglund and Carole and Jules Hertz visited Kirstie Kaiser at her home in Puerto Vallarta, Jalisco, Mexico. On 27 February 1995, the five of us traveled to Nuevo Corral del Risco (one mile south of Punta de Mita), Nayarit to collect intertidally at the low tide. Although the area looked ideal for collecting, there were only a few interesting things found. Most of these were minute species.

My find for the day was a large and very beautiful specimen of *Thais melones* (Duclos, 1832), shown in Figure 1. It was found in the low tide zone on sand among small rocks. When found it was apparently feeding on a large specimen of *Cerithium maculosum*, Kiener, 1841, which it had in its grasp.

The reported distribution for *Thais melones* is the Gulf of Tehauntepec, Mexico, to Callao, Peru, and the Galápagos Islands (Keen, 1971); Isla del Coco, Costa Rica (Bakus, 1975); and Isla Gorgona, Colombia (Cosel, 1984). The find reported here extends the distribution considerably to the north.

The author is indebted to Dave Mulliner for the photograph of the *Thais melones* specimen.

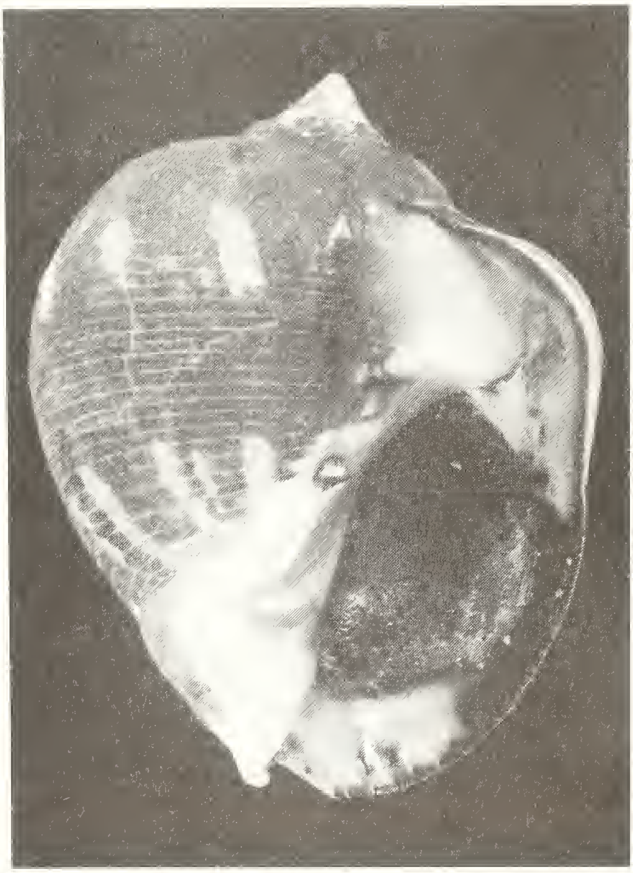

Figure 1. Apertural view of *Thais melones* (Duclos, 1832) specimen found at Nuevo Corral del Risco, Nayarit, Mexico. Length: 42.6 mm. Photo: D. K. Mulliner.

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Tulane University

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PROGRAM

Lost Molluscan Habitats of Okinawa

Kim Hutsell, who collected in Okinawa in the 1970s and 80s will give a slide presentation (with display), discussing the changes occurring on the island from the late 80s, resulting in the loss of molluscan habitats.

Shells of the month: intertidal Indo-Pacific shells
Meeting date: August 17, 1995

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CLUB NEWS

From the Minutes
San Diego Shell Club Meeting - July 20, 1995

President Kay Klaus called the meeting to order at 7:40 p.m. by welcoming guests. There were no corrections or additions to the minutes of the last meeting, so they were accepted without change. Kay thanked the many people (see July issue) who helped make the COA such a success.

Kay announced the Arnolds very graciously offered to host the September party at their home. The theme will be Italian. The date is set for September 9th at 6:00 p.m. There is a sign-up sheet for the potluck or $5 donation. There will also be electrical set-ups for hot trays available [see below].

Club tee-shirts, sweat shirts and Club mugs are still available for sale. Bill Romer reported that tonight's meeting was in the FYI section of the Tribune.

Carole Hertz presented the Club's winner of this year's Science Fair with his choice of Club book award, an inscribed copy of Morris, Abbott & Haderlie's **Intertidal Invertebrates of California**. The recipient, John Dekker Forest, gave an overview of his winning project, "Zonal Choice of the Limpet *Colisella limatula*," found along the west coast from Alaska to Baja. He discussed their preference to live in the higher intertidal zones.

Hugh Bradner gave a recap of the WSM meeting in Alaska, complete with slides of the event and of some of the participants.

Kim Hutsell introduced the speaker for the evening, Lindsey Groves from the Los Angeles County Museum of Natural History. Lindsey's topic, "Fossil Mollusks of Southern California," was from his thesis work from 1985-91. His slide presentation identified formations in the Simi Valley area and illustrated the fauna and their ages. He compared the Simi Valley area fossil mollusks with those of the San Diego Formation and commented on the similarities in the two. His photographs of sites and species were excellent, and his program was enjoyed by the large group in attendance.

Fossil displays brought in by several members, which included fossils from the west coast, were enjoyed by the members.

The winner of the drawing for the evening was Marge Bradner. The meeting was adjourned at 8:40 p.m. and everyone enjoyed socializing and the refreshments provided by the Lindahls and Don Shasky.

Silvana Vollero

A No-Host Picnic Supper Before the Meeting

Since the weather is warm and sunny and the days are long, it was decided to have a picnic supper, for all who wish to participate, before the August meeting. For those interested, the picnic site will be behind the Casa del Prado on the grassy slope between the fountain and the lily pool. The meeting time will be 5:45 p.m. to allow for a leisurely dinner before the meeting. So, bring your picnic supper and join the group.

The Annual September Party

The annual September party, this year with an Italian theme, will be held in the garden of Marty and Terry Arnold. The date is set for Saturday evening, September 9th and the festivities will begin at 6:00 p.m.

A sign-up sheet for potluck contributions will be passed at the August meeting (as it was at the July meeting). If you are unable to attend the August meeting but want to be included for the September party, contact either Terry & Marty Arnold (619-235-8181) or Kay Klaus ((619-292-4527). A map with directions to the Arnold home is on the last page of this issue. Don't miss the party. It'll be great fun!

A Dues Raise for 1996

Because the postage rates have risen, as well as the increased costs of paper for printing **The Festivus**, the Club has been forced to raise the dues for the calendar year 1996. Rates for domestic membership will be increased from the current $12.00 to $15.00 and overseas (surface mail) membership will be raised from the current $15.00 to $18.00. Overseas (air mail) rates will remain at the current $30.00. Rates for 1995 (available until October) will continue as published.

A Book Still Missing from the Club Library

Despite many pleas, the book, **Opisthobranchiate Mollusks of the Pacific Coast of North America** (the text not the plates) is still missing. If you have it, please contact Librarian, Margaret Mulliner (619-488-2701).

NEW DISTRIBUTIONAL RECORD FOR *CHICOREUS (PHYLLONOTUS) PERATUS* (KEEN, 1960)

KIRSTIE L. KAISER[1]

Museum Associate, Los Angeles County Museum of Natural History
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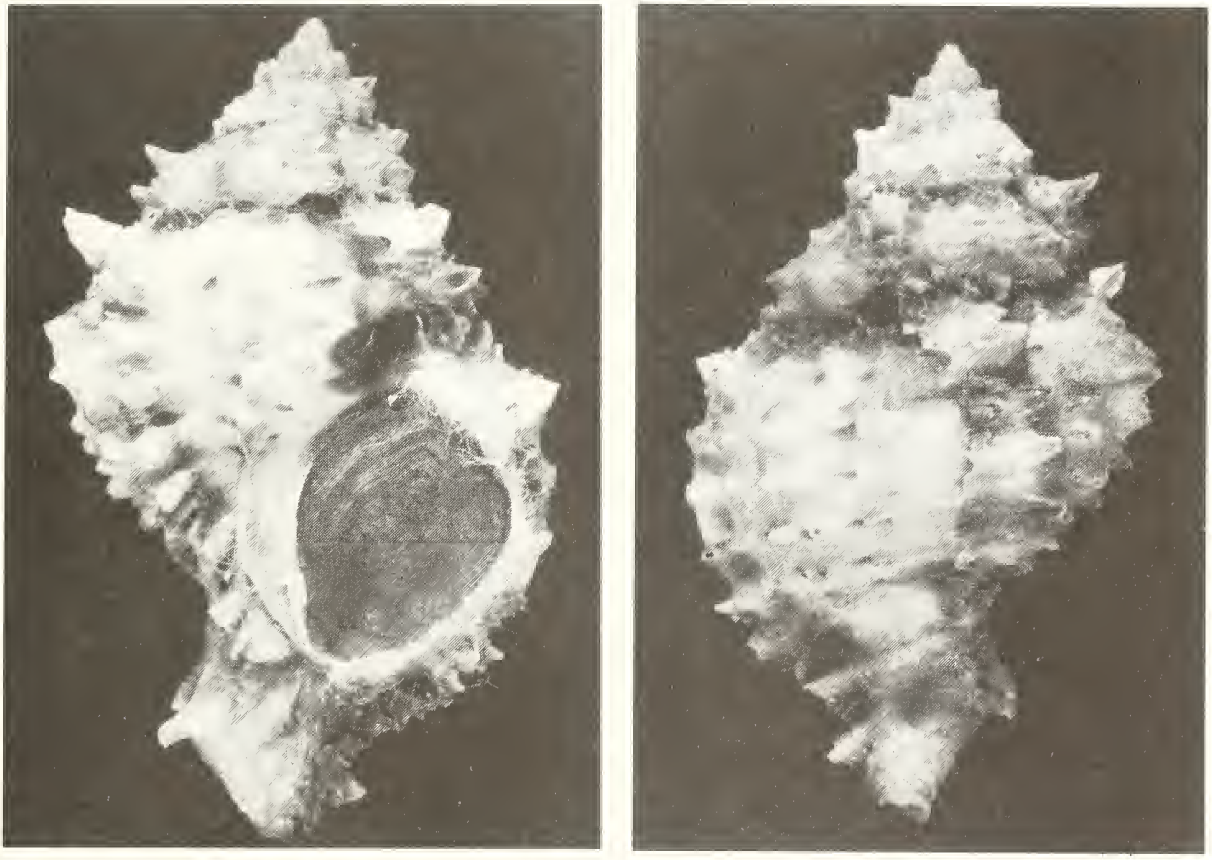
Chicoreus (Phyllonotus) peratus (Keen, 1960) (Figures 1 & 2), one of the uncommon muricid species from the Panamic province, has a reported distribution from the Gulf of Tehuantepec to Panamá (Keen, 1971). In February 1995, I was collecting near La Cruz de Huanacaxtle, Nayarit, Mexico, with Carole and Jules Hertz and Carol and Paul Skoglund. We noticed a commercial fishing boat that had anchored for repairs



Figures 1 & 2. *Chicoreus peratus* Keen, 1960. Apertural and dorsal views of 68.8 mm long specimen from fishermen. K. L. Kaiser collection. Photo: D. K. Mulliner.

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and we asked if they had any shells on board. They immediately said no, thinking that we were looking for "edible mollusks." Only after I pointed and asked about a dead broken *Hexaplex brassica* on the deck did they realize what we wanted. Suddenly they went off only to reappear with a smelly bag that included, among more common species, eight specimens of live-collected *Chicoreus peratus*, the largest of which measured 86.3 mm. They told us that the shells crawl up their long-line nets to eat the dead fish entangled therein, and that the collecting site where they laid their nets was 20 km east of the Islas (Tres) Marias Islands on a submerged plateau at a depth of 55-70 m. Figure 3 shows a picture of the fishing boat with Kirstie Kaiser, Jules Hertz and Paul Skoglund conversing with the members of the crew. When asked if we could pay them for their efforts, they promptly declined. However, we offered them a case of beer, and everyone departed feeling very rewarded.

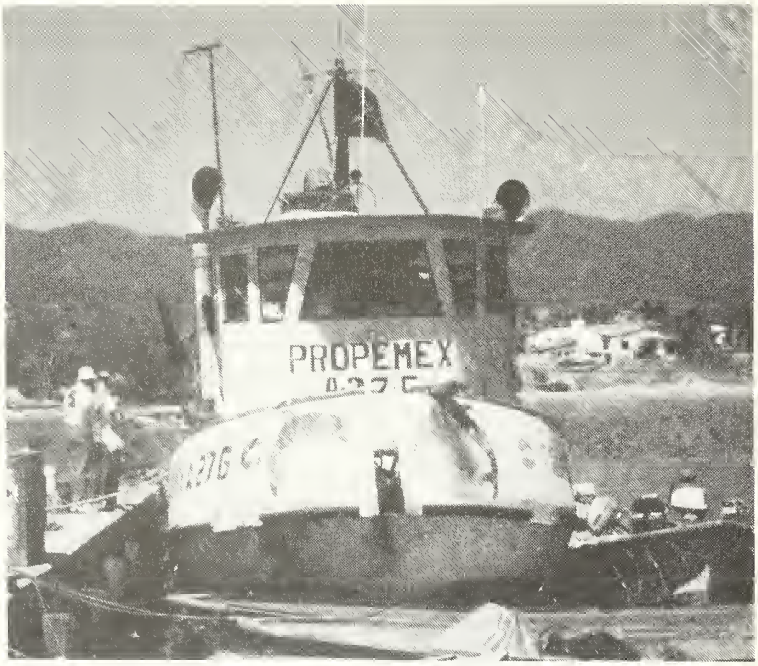

Figure 3. Jules Hertz, Paul Skoglund and Kirstie Kaiser "discussing" shells with the fishermen. Photo: C. M. Hertz.

LITERATURE CITED

KEEN, A. MYRA
1971. Sea Shells of Tropical West America, 2nd ed., Stanford University Press, Stanford. i-xiv + 1-1064 pp., 22 pls., ca. 4000 figs.

THE SHELL DESK DIARY FOR 1996 NOW AVAILABLE

Notice has just been received that the 1996 Shell Desk Diary is available for order now with delivery assured by November 1995 for those who enjoy giving these diaries as holiday gifts.

This year the publisher states that the diary features the Galápagos Islands "with spectacular color photography and descriptive text." The diaries sell for $9.95 each with an additional $1.25 for shipping and handling. For the Executive Diary, a special padded, black leather-patterned cover with gold foil stamping, the cost is $15.95 (with personalized stamping [max. 27 spaces] the cost is $19.95).

An order form will be available at the August meeting for those interested. For questions concerning the Diary, call Kellie Alvord of the Service Bureau at 713-868-6300 or 713-984-7518.

WSM GOES NORTH TO ALASKA

The twenty-eighth Annual Meeting of the WSM met at its most northern point in its history, 2-6 June 1995, about 50 miles northeast of Fairbanks, Alaska at the Resort at Chena Hot Springs. The meeting was attended by twenty-one registrants: eleven were tourists from the lower forty-eight, nine "native" Alaskans, one from Mexico and our symposium guest from Vladivostock, Russia. The accommodations were in a rustic setting, with a large indoor swimming pool and several hot tubs heated by the natural hot springs. Local color was added by a moose wandering through the grounds occasionally.

After welcoming remarks by President Nora Foster, Arny Blancard initiated the meeting proper with a presentation discussing reproduction of the mussel *Mytilus trossulus* in the Valdez area, the most significant point being that because of the inflow of pure fresh water, the species often survives and is stimulated to breed. They demonstrated no contamination by the hydrocarbons in the harbor. Malin M. Babcock followed by reviewing a method of removing the oil from the Valdez oil spill (still present five years after the event) and restoring the mussel beds. This is a feasible method but very labor intensive. Howard Feder reviewed the biology of the limpets in the Port Valdez area. There are six species and he was able to relate their size to age and show that there was a vertical spatial distribution both by species and by age. James H. McLean previewed his Checklist of Northeastern Pacific Gastropod Fauna, reporting that the text is 30% finished and will include approximately 100 new species. This was followed by his second presentation reviewing the changes in the taxonomy of the Alaskan Buccinidae. Hugh Bradner presented SEM radular comparisons of *Cypraea bicolor* and *C. piperita*, felt to be the same species by some authors. The radular studies suggest that they may be distinct valid species. The evening session was a slide show of various collecting trips and study experiences in Alaska.

On the second day of the meeting Nora Foster reviewed the malacological composition of several ancient early human middens found in the 1993 and 1994 Tongass Cave surveys. Terry Arnold discussed the Pliocene-Miocene migrations of fossil Cypraea and pointed out the difficulty in establishing the method of migration. David Hopkins explored the methods by which several gastropod species more typical of the Honshu, Kamchatka coast migrated to northern Alaska during past ages, and concluded that it was probably explained by a favorable current flow secondary to the emerging Bering land bridge during the past millennia.

The one submission in the poster session demonstrated the radular characteristics of seven species of Muricidae inhabiting the coast of Mexico, revealing a relationship between food preference and radular type. Two students reviewed their current work. One studied sponge ecology and the other the feeding habits of squid by analyzing stomach contents.

The field trip for the meeting was a hiking trip to Angel Rocks, a popular geologic landmark. After receiving a briefing of what to do if we encountered a bear (look big, stand your ground) or a moose (run, run, run), a courageous group set out. The three mile hike went along the Chena River, up through the woods, up the mountain side to a beautiful lookout with a grand view of the valley. Everyone developed a great appetite, which was assuaged by the Great Alaskan Barbecue. Salmon, chicken or halibut, broiled to order, with all the trimmings, was enjoyed by all.

The highlight of the meeting, a Symposium on Freshwater, Brackish and Terrestrial Mollusks, began the third day with Nora Foster presenting an overview of the similarities and differences between the northern Asian and the Alaskan species in terms of the number of species involved and their biogeographic affinities. Neil Fahy showed that there is disjunct distribution of *Cerion*, and speculated that human introduction might account for this distribution. Maria Diupotex reviewed the cytogenetic study of the chromosomes of *Physa*, a genus which exists in the effluents of the lake of Xochimilco. Larisa Prozorova, our symposium guest, illustrated the malacological affinities of the Kurile Islands showing that there was a stronger relationship to the southern Japanese islands rather than the closer Chinese mainland. This affinity was explained on the basis that there was likely to have been a land bridge with the more southern islands.

The evening was dominated by a wonderful presentation about the aurora borealis. Demonstrations, slides and a video were used to show the beauty of the "northern lights".

It was a very informative and enjoyable meeting! You should have been there!

George Metz

COA '95 -- SAN DIEGO REVISITED

June 23rd saw the return of the Conchologists of America to San Diego, this time to the beautiful Pan Pacific Hotel downtown. From registration (Figure 1) beginning on the 23rd (with the convenient "passport" program designed by Kim Hutsell) to the final field trip (Rosarito Beach in Baja) on the 29th, the convention was filled with events to keep the over 240 attendees very busy and happy.

Special events were well attended such as the Welcome Party with a beach theme on Saturday evening, hosted by the San Diego Shell Club (at which many attendees wore their new COA '95/San Diego Shell Club shirts). Two field trips on Sunday afternoon, one a fossil hunt and the other a search for land snails, were followed by a Sunday evening dinner cruise aboard the **High Spirits**, which name aptly described the mood of those on board this delightful dinner cruise around San Diego. A capacity crowd attended the COA auction on Monday afternoon (Figure 2) in which many rare and beautiful shells were actively bid upon. In the evening, a bus took many members to an open house and cocktail party at the new Stephen Birch Aquarium in La Jolla. Tuesday afternoon and Wednesday were reserved for the dealers' bourse (Figures 3 & 4), an event which filled the huge Emerald Ballroom with sellers, buyers and admirers. Wednesday evening saw members in their finest attire attending the beautiful banquet in the Crystal Ballroom with the music of the Gaslamp Jazz Band setting the mood. The dinner and decor were outstanding as was the program of "California Images" presented by the very talented photographer, Ken Bondy. Following the program, John Jackson, the

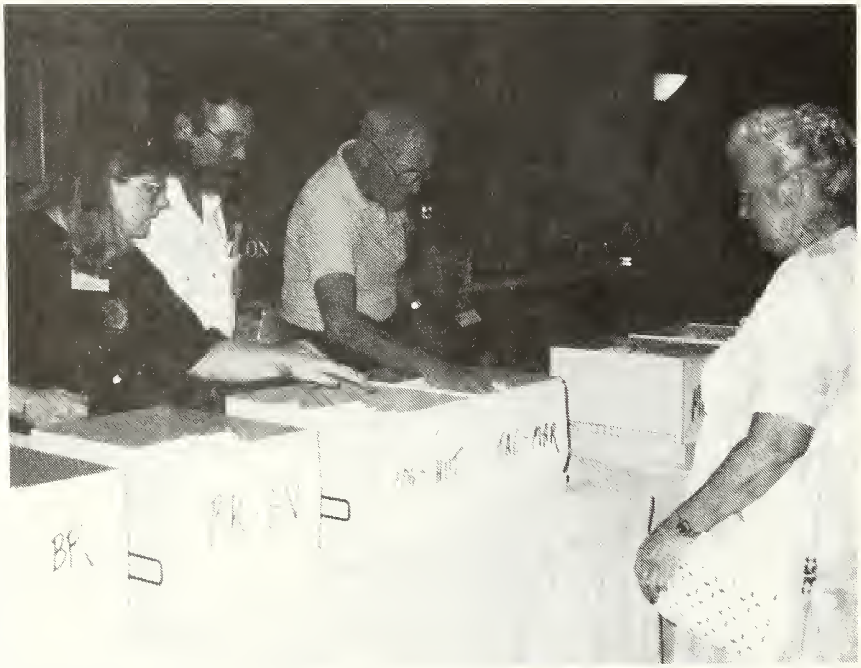
Figure 1. Registration with Linda and Kim Hutsell and Hugh Bradner manning the desk. Photo: D. K. Mulliner.

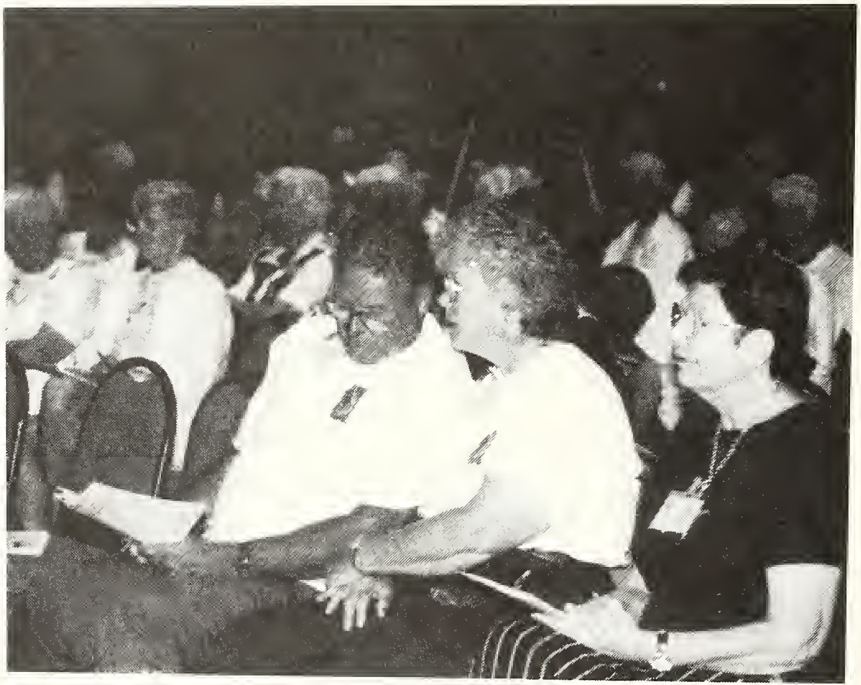
Figure 2. At the Auction. Nancy and Bill Schneider and Mary Regula up in front. Photo: D. K. Mulliner.

convention's consummate emcee, announced the winners of the raffle drawings for the donated specimen shells, and the three malacological books donated by the San Diego Shell Club. There were some very happy winners.

Figure 3. At the bourse, Jeanne Pisor with her display. Photo: D. K. Mulliner.

In addition to the many optional events, there was an impressive exhibit of shells (*Haliotis*, record size, freaks, and local shells) and photography, and some fine programs, interspersed with silent auctions and door prizes presented by attendees both local and overseas, professional and amateur. Members found the panel discussion "Conservation and the Future of Shell Collecting" of extreme interest in today's climate of increasing regulation banning all collecting. On a light note, Betty Jean Piech's talk, "Helpful Hints for the Shell Collector," had the audience responding with gales of laughter. Brian Hayes' slide program on The Marginellas of South Africa" and Chris Takahashi's on "Diving and Exploring Rapa Nui" made us all want to leave the hall and "go, get wet." In addition to introducing many in the audience to a new computer system for managing shell collections, Ron Voskuil took us all to Brittany and a mud flat made in heaven, while Paul Scott took us to the frozen Arctic (and Hong Kong) in "Eating My Work from the Frozen Arctic to the Steamy Tropics".

Figure 4. Club president Kay Klaus at her table at the bourse. Photo: D. K. Mulliner

The Club again thanks those persons who worked mightily to make the convention a success such as convention co-chairs Don Pisor and Kim Hutsell; Treasurer Wally Robertson; Registration chair Linda Hutsell, and Banquet chair and cruise planner, Ellen Jackson, as well as the other Club members who put in many hours behind the scenes and were thanked in the July issue of **The Festivus**.

It was an exciting week!

Carole M. Hertz

TECHNIQUES IN PREPARING AND PHOTOGRAPHING *CYPRAEA* RADULAE

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INTRODUCTION

This paper deals with the preparation of the radula of species of *Cypraea* for taxonomic studies using scanning-electron and optical microscopes (SEM and OM) to obtain high resolution images of tooth shapes, and to determine the existence of bracts at the base of teeth. It describes the development of the techniques, with emphasis on current methods. SEM is capable of more than 100 times greater depth of field and resolving power (viz. sharpness or magnification) than OM, but it shows only the surface features of the specimen. It can not reveal the interior structure. Specimen preparation for other studies such as radula growth rate, mechanical features, structure and functioning can require different techniques that are well described in a number of publications. (See for example: Bowell (1924), Hickman (1977), Meeuse (1950), Ploeger & Breure (1977), Solem (1972).)

Initial work by the first author anticipated using just SEM, and included experiments with several different preparation and mounting techniques. Later work with OM called for selection of appropriate mounting and staining techniques.

CARING FOR THE SPECIMEN BEFORE EXTRACTING THE ANIMAL

The most satisfactory, but rarely possible, procedure is to extract the animals within a few hours after collecting. For longer storage they can be put in a freezer, or can be preserved in alcohol or formalin. If specimens are allowed to decay, the animal acids will attack the radula. Radulae from cowries larger than 2 cm are usually damaged if the specimen is left in air more than about two days. Smaller specimens can usually be left to dry, even in tropical climates. To prevent excessive animal decay, the specimen can be soaked in about 50% alcohol for a day or more and then either left in the alcohol or air dried. Ethyl alcohol is recommended, but denatured ethyl is satisfactory. Isopropyl alcohol (rubbing alcohol) can be used at between 80% and full strength. Methyl alcohol (methylated spirits) is satisfactory at about 50% concentration if a handful of coral is stirred into a quart of liquid an hour or more before use. This neutralizes the weak acid that can otherwise give a milky sheen to the shell.

Alcohol-soaked specimens and some air-dried specimens have yielded good radulae, even after being stored more than 20 years.

EXTRACTING THE ANIMAL

Fresh animals can usually be removed from the shells by a strong jet of water. Ordinary house water pressure through a good quality garden hose nozzle is usually adequate. The nozzle should be inserted through the side of a bucket or deep bowl which is filled to above the nozzle level before use. This prevents water from splashing, and also retains the shell and extracted animal. A foot-controlled water valve is convenient. Removal is facilitated by alternately freezing and thawing the specimen several times before extracting the animal.

Animals can often be removed by probing with a large safety pin or a dental tool if the foot extends at least a small distance out of the shell. Freshly collected specimens can sometimes be induced to die in this condition if they are placed in salt water which is slowly raised in temperature, for example in a jar in sunlight. Cooling a cowrie by placing it on a piece of ice is said to produce the same result.

Some collectors report successful extraction of fresh specimens by placing them briefly in a microwave oven. Specimens should be put inside zip-lock bags to catch all the animal fragments that can splatter when the animal suddenly boils. Successful extraction should occur in a few seconds, and is accompanied by a small but audible pop. Excessive time in the microwave will harden the animal, and may hamper subsequent efforts.

Air-dried and alcohol-soaked specimens can be rehydrated by soaking in an aqueous solution of trisodium phosphate.

Even shells that appear to have been well-cleaned can sometimes yield a few teeth in a strong water jet since the buccal mass of a dying cowrie tends to be pressed into the innermost whorls of the shell.

If breaking the shell is permitted, the animal can be easily removed by prying apart the aperture with two screwdrivers, or cracking the shell in a vise.

If the shell must not be broken but the animal can not be removed by water jet or probing, it can be removed....although with some degradation....by soaking in potassium hydroxide (KOH). Anterior and posterior channels should be plugged with silicone-RTV, and any valuable shell thoroughly coated with vaseline to prevent dulling its luster if KOH is spilled. The shell should be placed aperture-up and carefully filled with a 10% to 40% solution of KOH; a medical syringe is useful for this operation. After soaking for a day, the animal can be flushed out of the shell by a gentle stream of water.

EXTRACTING THE RADULA

The radula is removed by mid-dorsal incision of the buccal cavity, or by probing and cutting around the base of the head until the radula is located, then teasing it out with fine instruments. Cernohorsky (1971) gives a good description of the procedure for finding, removing, and cleaning radulae. A dissecting microscope is useful, even when working with large specimens. The extracted radula, held by the large end with tweezers, is cleaned by a wash-bottle jet of distilled water and then immersed in 10-40% KOH for a day to hydrolyze, macerate and remove extraneous material. The chitinous radula remains. It is then washed again with a wash-bottle jet of distilled water, placed in a vial of water and the vial immersed for half a minute in an ultrasonic cleaning bath. After another washing by water jet, the radula can be examined with a dissecting microscope under high magnification. Most of the remaining tissue can be removed with a fine artists brush; and the process, including the KOH soak, repeated if necessary.

Normally, radulae are manipulated under the dissecting microscope to establish topographic relationships, and then sections are mounted on SEM stubs and optical slides, or are stored in vials. When possible, a segment from the middle section of the radula is used for SEM study, while the adjacent section toward the large end is used for the optical slide. Initially, radulae were stored in vials in water or 50% ethyl alcohol; but occasional curling, disintegration of the ribbon, or evaporation of the liquid led to the procedure of drying the specimen on smooth light cardboard under an unweighted microscope slide; then storing the card in a vial.

A common procedure of weighting or drying specimens between rubber-banded microscope slides often fractures the radula teeth, as does excess heating during coating for SEM (described below). Fracturing becomes more severe with room-condition storage for several months or years. Critical point drying or freeze drying and subsequent storage in a desiccator might be useful, especially on large specimens.

MOUNTING THE SPECIMEN FOR SEM

Initially the philosophy stated by Solem (1972) was followed: "The more bends, folds and tears, the greater the variety of information that can be extracted from a single mount." Specimens were folded over fine wires or splinters in the manner of Ploeger & Breure (1977); or wrapped several turns around sewing pins, or around conical stubs (Figure 1). Teeth of some specimens were separated from radular ribbons by soaking in 5% glusulase for several days, or in 20% Clorox for a few minutes, and were distributed on ordinary SEM stubs to obtain stereo photos of individual teeth.

Photos with folded and twisted radulae, conical stubs, and stereo photos of individual teeth are very

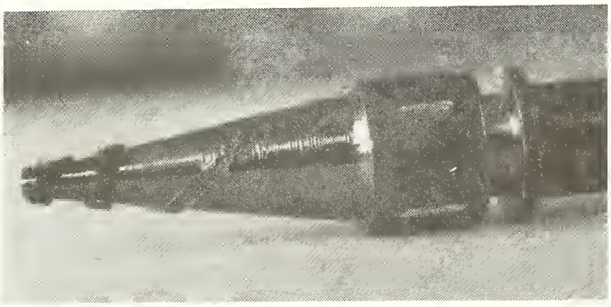

Figure 1. Conical stub for SEM radula mount.

good for revealing the features to observers who are skilled in viewing three-dimensional objects via engineering drawings or via stereo visualization (Figures 2 & 3). They are not appealing to zoologists whose experience is mainly in optical microscope photos or drawings that are always made from directly above the specimen. For this reason segments of the radula were mounted flat on SEM stubs, and then were photographed from three directions as described below in the section on PHOTOGRAPHY...SEM. The following procedure was adopted as standard.

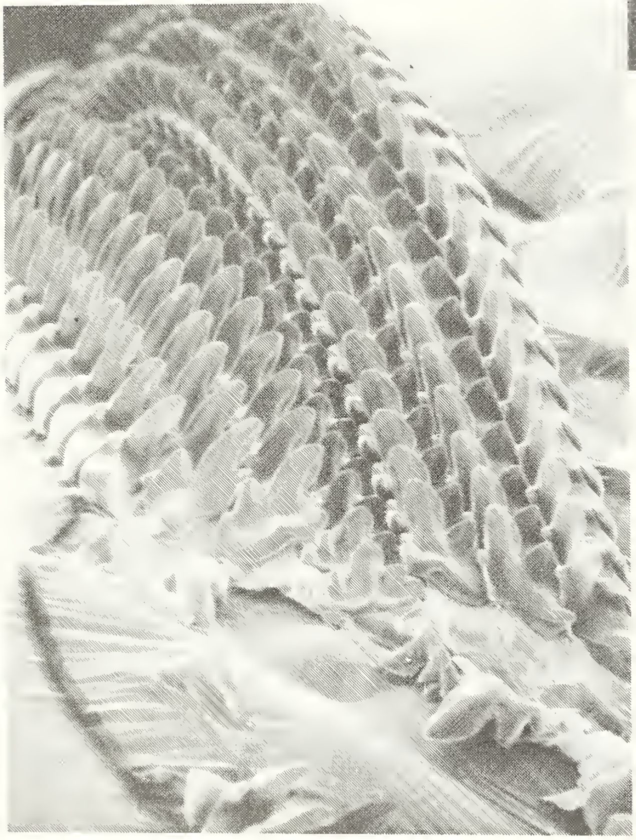

Figure 2. SEM photo of *C. lynx* on conical mount.

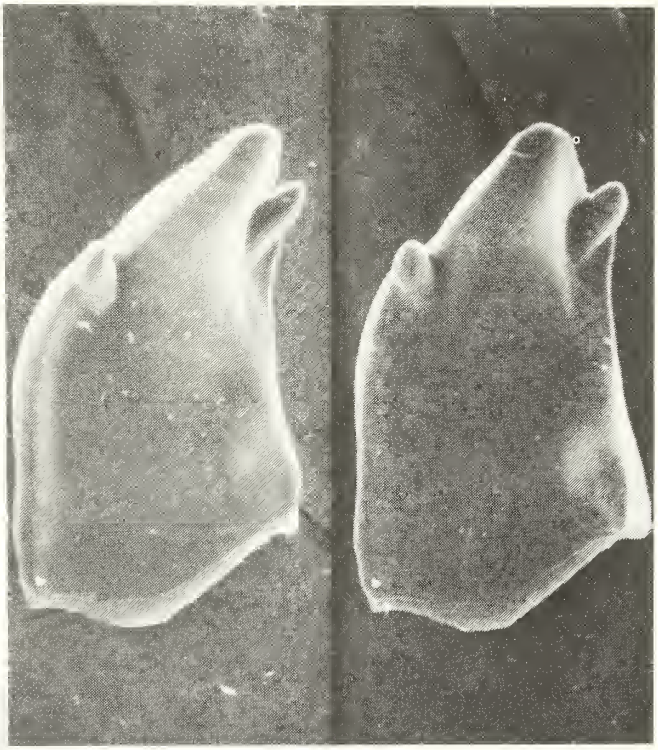

Figure 3. SEM stereo mount of lateral tooth of *C. surinamensis*.

The SEM stub must first be coated with a thin layer of adhesive. Commonly this is two-sided clear masking tape, Avery "Spot O'Glue" or equivalent. Solem (1972) recommends Sanford's Rubber Cement in preference to Duco Cement or Elmer's Glue. Dry radulae will stick to any of these adequately, and alcohol-wet radulae can usually be positioned and stuck during the short time before the alcohol evaporates. But they are not good for use with water-wet specimens. An excellent material is Underwater Kinetics' "Wet Suit Weld", a contact cement that will hold a damp radula in place. The damp specimen should be mounted on the stub between five minutes and two hours after coating. It can be placed, manipulated, flattened by tweezers and fine artists' brush. Water is then removed by Whatman Glass Paper or other lint-free filter/blotter. After the specimen is fully dry, a few teeth are removed from the end of the specimen, to provide a clear view of the central tooth as desired for the SEM photographs. This removal can be done on even the smallest cowrie radula by working under a X120 dissecting microscope, with a very fine point needle, sharpened on Arkansas stone or with a short fine hair glued to the needle point.

Needles can be held in a pin vise or a small diameter wood like a cuticle stick. Delicate manipulation can be achieved by lightly pressing together the fingers of opposing hands. The first author has made a two-axis micrometer stage for a dissecting microscope, and also has experimented with piezoelectric and with electromagnetic manipulators, but has found that hand-controlled manipulation is satisfactory, and much more convenient.

We did not have access to a SEM that can be used with non-conducting specimens, so we used ordinary gold sputter-coating methods to provide an electrically conducting surface. We did run at half the usual current for three times the usual time, to reduce the stub heating which can fracture teeth of large radulae. Specimens are coated twice. Between coats the bell-jar is let down to 100 microns pressure of argon or dry nitrogen, then to atmospheric pressure air. It is not necessary to use electrically conducting paint or colloidal graphite between the "Wet Suit Weld" and the aluminum stub.

MOUNTING THE SPECIMEN FOR OM

The literature on mounting specimens for optical microscopy has been voluminous for 150 years. Extensive discussion can be found in Emmel & Cowdry (1964), Galigher and Kozloff (1971), Gray (1973), Lee (1950), Loveland (1970), Peacock (1973), Radwin (1969), etc. In this paper we will discuss only factors that are significant to taxonomic studies of *Cypraea* radulae where the interest is in internal tooth bracts and tooth surface contours.

A homogeneous transparent object immersed in a material with the same refractive index will be invisible unless the object and the mountant are different colors. If the object is polarizing or has inclusions with different index of refraction it can be seen if illuminated between crossed polaroids.

If the object has a refractive index different from the mountant its surface can be seen, but any internal features will become progressively more difficult to observe as mountants of progressively higher or lower index are used. Microscopists disagree regarding whether the mountant index should be higher or lower than the object index. The Vade-macum for example (Lee, 1950) states that media having a lower index than the object will give diminished transparency but greater visibility of colorless unstained elements, while media having higher index than the object will give great transparency but diminished visibility of the elements. Emmel & Cowdry (1964) agree that the mountant index should be lower. Bowell (1924) concludes the reverse, while Galigher & Kozloff (1971) state that it may be either below or above.

Cowrie radular teeth can be considered as small transparent objects surrounded by transparent mountant. If the refractive index of object and mountant are not equal, we can use transmitted light to observe surface contours as well as possible internal regions that have different refractive index: Some of the light striking the bottom of the object is transmitted; some is reflected. The transmitted light passes through the object to its upper surface where some light is reflected and some light is transmitted to the microscope lens. Quantitative treatment can be found in texts on physical optics. See, for example, Jenkins & White (1976). For all ordinary mountant refractive indices, adequate light is transmitted provided that the teeth are wet by the mountant. If we consider visibility of the elements to be measured by the ratio of light intensity from rays that strike parts of the object obliquely vs. rays that strike it normally, we can show by simple physical optics that high mountant index should give the better visibility of surface contours, though the difference is slight. Availability of good chemically neutral mountants with desired refractive index is probably a more important consideration.

The above remarks concern mountants that have different refractive index than the radula teeth. Unfortunately, radulae of some cowries were found to have refractive index practically identical with that of the mountants. Satisfactory photographs of unstained specimens could usually be obtained by using crossed polarizers or a novel "half-field" illumination described later in this paper. In a few cases the specimen was removed, stained, and remounted.

We desired a permanent medium to produce archival slides, which could nevertheless be dissolved at any time if desired to recover the specimen. Water soluble mounting media such as Turtox often give bubbles after a few months of drying, though James Tobin contributed some excellent slides with *Cypraea* radulae that had been stained and mounted in water-soluble medium. (Some of them did need to be remounted.) Xylene soluble mounting medium has traditionally been Canada balsam which has a published refractive index of 1.534 to 1.540, very close to that of many cowrie radulae. Its increasing cost and the desire for a wider range of refractive indices has led to the use of synthetic mountants. Alison Kay contributed excellent slides with radulae mounted in Canada balsam or Euperal (published refractive index 1.483). I standardized on Canada balsam and Preservaslide (measured refractive index 1.522).[1]

A section is removed from near the broad end of the radula, flushed repeatedly with alcohol, and dried overnight on a smooth cardboard under a microscope slide. The slide is not weighted. Then the dry radula section is transferred to the specimen slide with tweezers or fine brush. A drop of xylene is put on the specimen to displace the air,, and a line of mounting medium is run near the specimen before the xylene evaporates. A cover slip is placed over the specimen, and the assembly is dried in a 55°C oven for a week.

Specimens can be demounted at a later time, if desired, by soaking the slide overnight in warm xylene, lifting the cover slide and the radula, and flushing the radula repeatedly with a gentle jet of xylene. Alternatively, the residual mountant can be removed in a vapor phase degreaser.

STAINS

Stains, like mountants, have been intensively studied for 150 years. A few treatises are listed here: Clark (1981), Conn (1960), Emmel & Cowdry (1964), Gurr (1962), Lillie (1969). The chief purpose of stain in this *Cypraea* radula study was to improve the quality of photos when teeth and mountant have nearly equal refractive indices; but stains can be used to investigate other things about radulae. For example Gabe & Prenant (1957, 1958) studied the development from soft new teeth to tough mature ones. Staining can be viewed as a chemical reaction in which the intensity of color is related to the nature of the stained material. Protein cross-linkages in the tooth chitin can vary from tooth base to tip, resulting in heavily stained tooth base; and will change with maturity of the tooth, resulting always in uneven staining along the ribbon.

Bowell (1924) discusses differences between acidic and basic stains, and notes especially how different segments of radulae are stained by eosin, chrysoidin, and oxidation dahlia. The last stain modifies chitin so profoundly that it no longer shows polarization.

The choice of stain seems often to be based on familiarity and availability rather than on considerations of chemistry. Table 1 shows the recommendations of several people for staining cowrie radulae.

TABLE I

SUGGESTED STAINS FOR COWRIE RADULAE

A. D'Attilio	cresyl violet
T. Gosliner	acid fucsin
M. Jay	chrysoidin
A. Kay	oxidation dahlia
T. Price	eosin or basic fucsin
G. Radwin	any eosin stain

W. Cernohorsky and all of these people apparently also mount radulae without staining.

Some of the Bradner radulae were stained with 0.2% acid fucsin. Most were prepared without staining, and were photographed with half-field illumination or between polarizers which were rotated to show most clearly the internal features of the teeth. A few specimens were photographed with Nomarski microscope: Lang (1968), Loveland (1970). Some of Kay's radulae had been stained by a modified oxidation dahlia technique.

PHOTOGRAPHY...SEM

Photographs were made with conventional techniques on commercial scanning electron microscopes. The instrument was operated at 15 kilovolts with the specimen holder set at 15 mm working distance. Each specimen was photographed from three directions to facilitate visualizing the tooth shapes. Photographs were taken from (a): the familiar optical photomicrograph view directly above the specimen (stage at 0°), (b): looking along the ribbon, with the stage tilted at 60°, (c): stage at the same tilt angle of 60°, but rotated 45°, to view the ribbon obliquely, as shown in Figure 4. Figures 5a,b,c show the three views of another specimen from the same population. Photographs were made with Polaroid 55 P/N or 665 P/N film.

PHOTOGRAPHY....OM

Photography of unstained radulae in ordinary

---

[1] Note added during manuscript preparation: Dr. Annika Sanfilippo of Scripps Institution of Oceanography has discovered that Preservaslide mounts appear to be crystallizing after 10-year storage. The only known reliable cure is to dissolve the Preservaslide and remount the specimens.

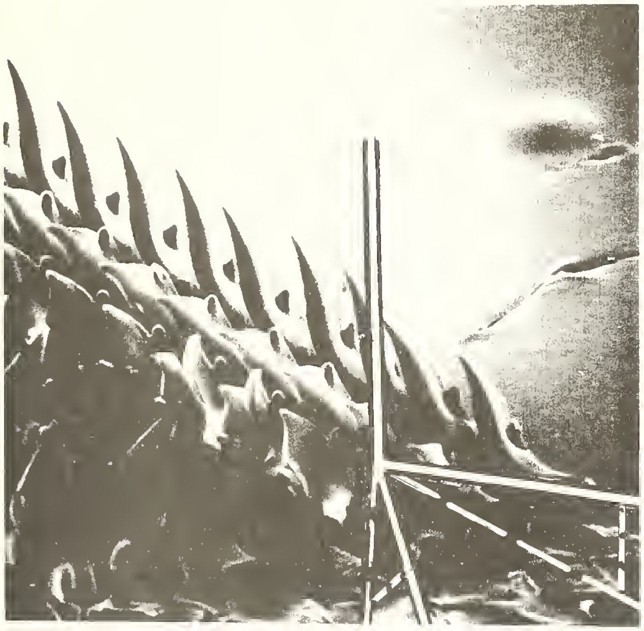

Figure 4. Standardized view directions for SEM photographs (*C. cernica*).

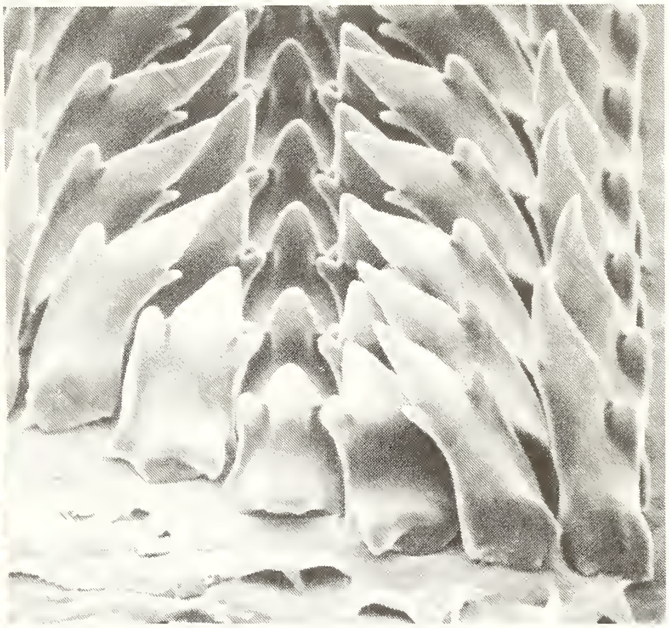

Figure 5b. SEM photo of *C. cernica*, specimen 2, looking along the ribbon.

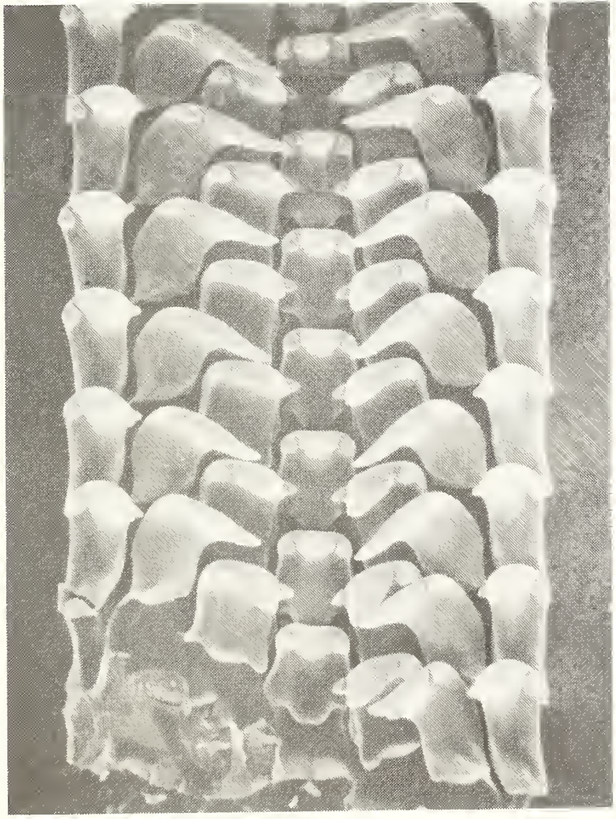

Figure 5a. SEM photo of *C. cernica*, specimen 2, viewed from directly above specimen.

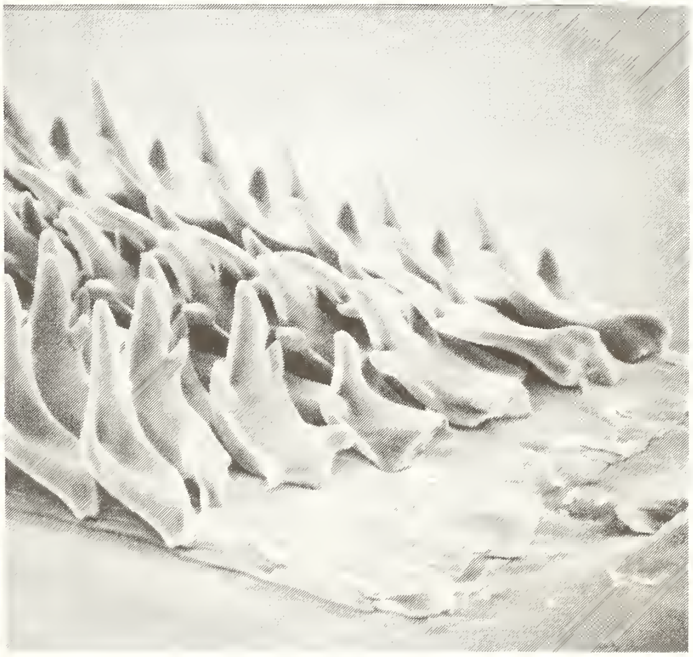

Figure 5c. SEM photo of *C. cernica*, specimen 2, oblique view of ribbon.

microscope illumination is difficult if the refractive index of the teeth and the mountant are nearly equal.

Fortunately, many specimens are polarizing, and hence could be recorded adequately by placing the slide between appropriately crossed polarizers or crossed polarizers with a quarter-wave plate. Color film may be better than black & white for these images. Nomarski microscopy can also produce good images of difficult specimens. Bradner used a novel illumination which produces a nomarski-like image by obscuring about half of the aperture of the incident light. He simply laid a pencil across one half of the blue-green filter above the diaphragm at the base of the microscope. A good comparison of techniques is shown in Figures 6a,b,c.

Photographs were made with an auto-exposure camera, set at ISO 400 with Kodak Tri-X film, and developed in microdol; or set at ISO 100 with Kodak T-Max film, and developed in T-Max developer. Color photographs in crossed-polarizer illumination were made with Kodak Gold ISO 200 or equivalent film.

INSTRUMENTS AND MATERIALS:

Scanning Electron Microscopes:........ISI Super III A.
.........Hitachi S-405A.

Dissecting Microscopes:..................Spencer AO with X1, X2, X3 objectives and X10, X15 oculars.
............Spencer AO with X2, X4, X8 objectives and X5, X10, X15 oculars.

Photomicroscopes:........................Zeiss compound microscope with geological rotating stage, operated with substage condensers removed; with X2.5, X4, X6.3, X10, X16 planapo objectives; and X9 or X16 projection eyepiece....Olympus OM-2N, 35mm camera.
...............................Zeiss Axiomat. Zoom magnification with self-contained camera.
..................................Nomarski, Zeiss Photomicroscope III with self-contained camera.

Ultrasonic bath:............................Branson B-12, 80 watts.

Preservaslide:..............................PX 1640-1. M.C.B. Reagents, 480 Democrat Road, Gibbstown, NJ 08027. Phone (609) 423-6300.

Wet Suit Weld:......................Underwater Kinetics, 1020 Linda Vista Drive, San Marcos, CA 92069.

Distilled water and laboratory grade reagents are recommended wherever possible. Deionized water has been used successfully in cleaning radulae. Ordinary tap water and sea water have been used for diluting alcohol in the field. Denatured ethyl alcohol and even "methylated spirits" (methyl alcohol) have been used when necessary.

Figure 6a. Optical photos of *C. artuffeli* (a) normal illumination.

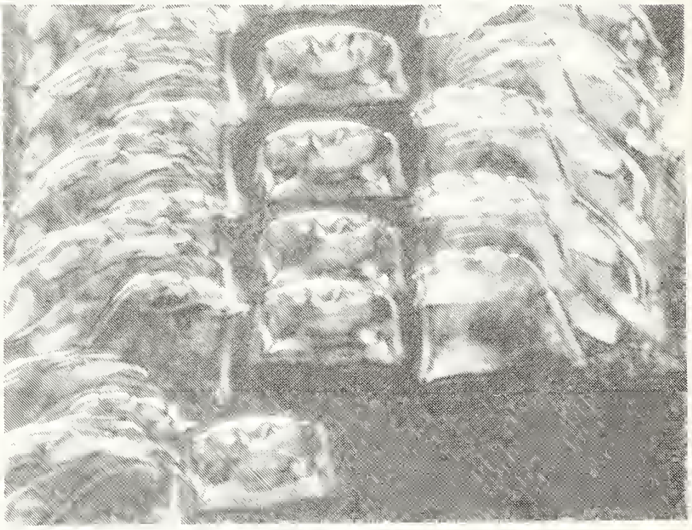

Figure 6b. Optical photo in polarized light.

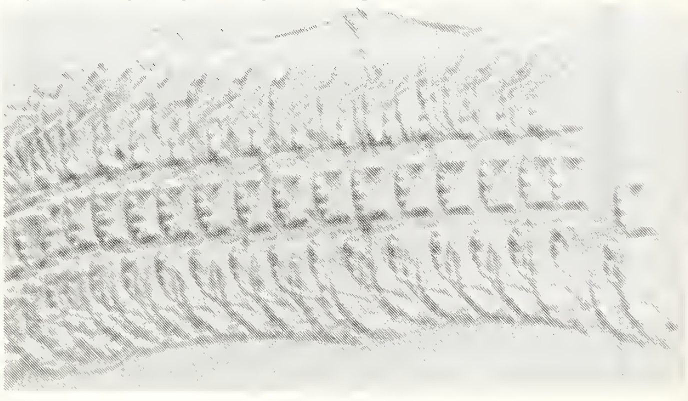

Figure 6c. Optical photo, half-field illumination.

ACKNOWLEDGMENTS

The first author acknowledges helpful discussions with Drs. Annika Sanfilippo, Theodore Bullock and Anne Dutton. His work was supported by a grant from the Director, Scripps Institution of Oceanography.

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ISSN 0738-9388

THE FESTIVUS

A publication of the San Diego Shell Club

Volume: XXVII September 14, 1995 Number: 9

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SEP 1995

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Meeting date: third Thursday, 7:30 P.M.
Room 104, Casa Del Prado, Balboa Park

THE SEPTEMBER PARTY

There is no regular meeting this month.

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CLUB NEWS

From the Minutes
San Diego Shell Club Meeting - August 17, 1995

Kay Klaus opened the meeting at 7:35 p.m. Minutes of the July meeting were approved as printed in **The Festivus**. The September party is coming up soon. Anyone interested in giving a $5.00 donation instead of bringing a food dish may contact Kay. The food dish sign-up sheet was passed around.

Club tee shirts, sweat shirts and Club mugs are available at the back table at the Club meetings.

Bill Romer announced that he had sent 18 letters to local newspapers and the Club was written up in the Wednesday FYI section of the Union-Tribune. We have received three calls since Wednesday inquiring about the Club.

Kay thanked Vi and Tommy Thomas and Bill Romer for providing the evening's refreshments.

The speaker of the evening needed little introduction since he is so well-known to Club members. Kim Hutsell shared his knowledge of Okinawa in his very interesting slide program "Lost Molluscan Habitats of Okinawa." He called it " a place to dream about for shelling" due to the richness of shells intertidally and in the deep waters. Many of the intertidal flats such as Ona Flat were especially rich in cowries and diving conditions were excellent. More recently, however, these areas are being filled, destroying entire habitats miles in length. Kim's closing advice was to go to Okinawa before the beauty is gone forever.

Several guests were introduced and the shell drawing winners were Bill Romer and Chuck Reitz. The meeting was adjourned at 8:30 p.m. to enjoy the refreshments and the variety of great specimen shells brought in by Kim Hutsell and Chuck Reitz.

Silvana Vollero

A Dues Raise for 1996

Because the postage rates have risen, as well as the increased costs of paper for printing **The Festivus**, the Club has been forced to raise the dues for the calendar year 1996. Rates for domestic membership will be increased from the current $12.00 to $15.00 and overseas (surface mail) membership will be raised from the current $15.00 to $18.00. Overseas (air mail) rates will remain at the current $30.00. Rates for 1995 (available until October) will continue as published.

In Memory of Walter E. Sage, III

The following information from Dr. William K. Emerson announces that the American Museum of Natural History plans to identify the Department of Invertebrates' Malacology Fund as the William E. Old, Jr./Veronica Johnson/Walter E. Sage, III Malacology Fund. It is a permanent fund used to support the Museum's reference collection of mollusks and molluscan research. Only the income generated from the Malacology Fund is available to use annually in order to keep the principal intact for perpetuity as a pro-rated part of the Museum's general endowment.

Any contributions received from Walter's friends and colleagues will be deposited into the Fund. All contributions should be made payable to the American Museum of Natural History, for the Walter E. Sage, III Fund and mailed to the American Museum of Natural History to the attention of William K. Emerson.

Additions to the Roster

New Members

Bowyer, Bruce & Diane, 30663 San Pasqual Rd., Temecula, CA 92591. 909-676-8702.
Kanner, Paul H., 10609 Esther Ave., Los Angeles, CA 90064. 310-559-7140.
Metzger, Ted, 14121 Hermosillo Way, Poway, CA 92064. 619-679-7737.
Price, Ali L. & Kevin Martyn, 31500 - 1st Ave. So., #22-303, Federal Way, WA 98003. 206-941-2349.
Sumrall, Burl & Song, PO Box 120723, Chula Vista, CA 91912. 619-476-9420.
Titselaar, Frederick, P.A. Stg. Memo Les, Postbus 63206, 1005 LE Amsterdam, The Netherlands. 020-6155333.

Change of Address
Trego, Kent, 441 Ravina St., Apt. 3, La Jolla, CA 92037. 619-456-7655.

EULIMID CALLS FIRE URCHIN "HOME"

RON H. McPEAK

7989 La Brusca Way, Carlsbad, CA 92008, USA

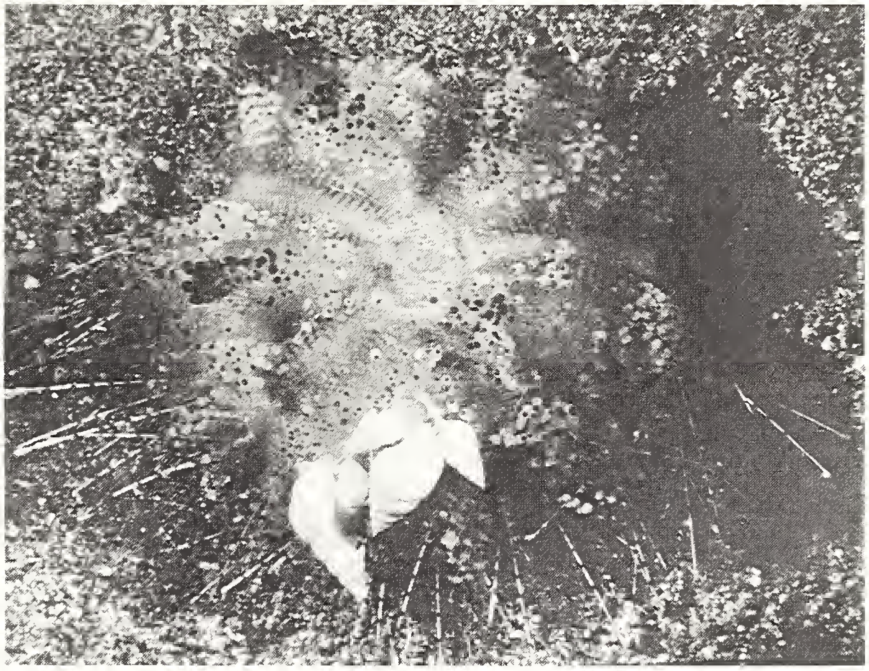

Figure 1. Fire urchin with five specimens of eulimid gastropod. Black & white photo by D. K. Mulliner from a color slide by the author.

I recently joined fellow San Diegan Mike Miller and San Diego Shell Club members Bob Yin and Dave Mulliner on an exciting dive/photography trip to the Philippines. During late February 1995 we dived off SeaFari, a rustic dive resort on Balayan Bay, about 50 miles south of Manila.

On several of the dives off SeaFari, I noticed large white eulimids feeding on fire urchins (*Asthenosoma varium*). The sea urchins, which were usually seen crawling slowly over the soft bottom at depths ranging from 20 to 60 feet, frequently had from two to six eulimids attached to their body (Figure 1). These snails have a pink appearance when alive.

Several snails were collected by carefully dislodging them from the surface of the urchin with a knife, being careful not to touch the venomous spines of the aptly named "fire urchin." I learned firsthand, on a previous dive in the Philippines, just how venomous these urchins can be. I had found one in a cave and tried to move it out for photography with my gloved hand. The sharp spines penetrated my glove and the pain was instant. I was so shocked that I involuntarily spit out my regulator and it took a few seconds of groping to retrieve my air supply. It is also interesting to note that fire urchins do not have a hard test but one that is flexible. With armature of fire, presumably the hard test is not necessary for protection.

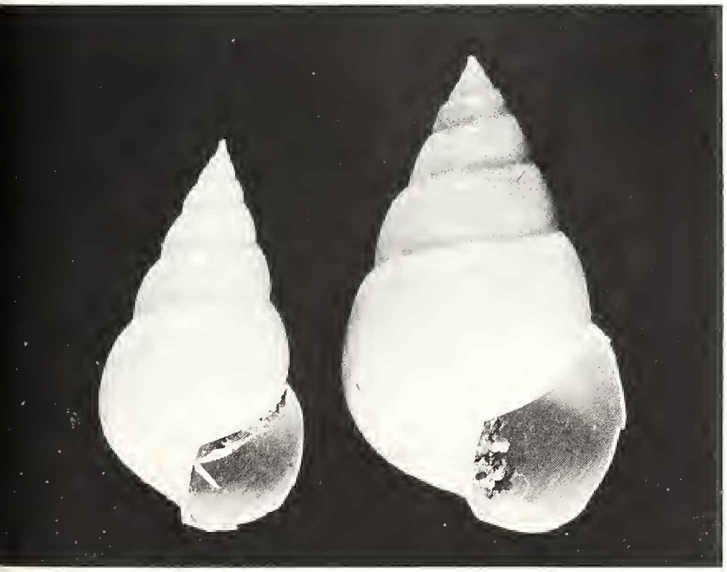

Figure 2. *Luetzenia asthenosomae* Warén, 1980, collected live on fire urchin. Lengths: 12.2 & 15.5 mm. Photo: D. K. Mulliner.

Dr. Anders Warén of the Swedish Museum of Natural History identified the eulimid as *Luetzenia asthenosomae* Warén, 1980 (Figure 2). Dr. Warén had described the species from three specimens collected from the same host urchin off Queensland and northern New South Wales, Australia, and stated that he had not seen any specimens since. The specimen sent to

Dr. Warén is now in the collection of the Swedish Museum of Natural History. This is the first report of the species in the Philippine Islands.

I wish to thank Dr. Warén for identifying the eulimids and Dave Mulliner for taking closeup photographs of the eulimid specimens and making a black & white print of my color slide of the fire urchin.

ADDITIONAL NOTES ON *PERSONELLA PUSILLA* (PEASE, 1861) (TONNACEA: PERSONIDAE)

DONALD R. SHASKY

4990 Nighthawk Way, Oceanside, California 92056, USA

In concluding my previous paper (Shasky, 1992) on *Personopsis pusilla* I mentioned, "I suspect that when collectors around the Indo-Pacific begin to shake corals and stones we will find that this species has a much greater range than is now known."

Nine months later my Tahitian friends Patrick Lilloux, Joel Flour and I dove at both Moorea and Tahiti. We were surprised at the numbers of specimens of this exotic little species we found. Previously, only a single specimen had been reported from Tahiti.

During September 1994, I found several specimens while diving on the reefs and islands off the far northwest of Western Australia. Since I did not know of any previous reports of this species being found in Australia, I wrote to Ian Loch, the Collections Manager of the Australian Museum in Sydney. He replied that he did not know of any published record of this species having been found in Australia. He also informed me that the museum had one specimen from Yonge Reef off Lizard Island and one specimen from Euston Reef off Cairns. Both of these sites are in northeastern Queensland.

My records are as follows:
Seringapatan Reef, in 13-31 m, 4 specimens
Hibernia Reef, in 12-22 m, 3 specimens
Cartier Island, in 28-42 m, 1 specimen

LITERATURE CITED

SHASKY, DONALD R.
1992. Notes on *"Distorsio" pusilla* Pease, 1861 (Tonnacea: Personidae). The Festivus 24(10):113-115, figs. 1-4.

SUCCINEA CALIFORNICA IN SAN DIEGO

RICHARD CERUTTI

Department of Paleontology, San Diego Natural History Museum,
P.O. Box 1390, San Diego, California 92112, USA

When I was out in the field with associates in the Paleontology Department, I discovered a species of land snail I had never seen before. I was unable to identify the specimens and brought some of these tiny, living mollusks in to the museum to show Carole Hertz in hopes that she knew what they were. When she could not identify them, she offered to find someone who could and sent the five live-collected specimens to Dr. Walter Miller at the Santa Barbara Museum of Natural History who kindly identified the specimens for us as *Succinea california* Fischer & Crosse, 1878.

I had found the snails in several localities: on the north side of State Route 54, east of Woodman Street, San Diego, under rocks in April 1994, and in flat areas that hold water (but not in the water) near Wabash Creek, at East C Street where freeways 94 and 15 intersect, on 16 January 1995 (Figure 1), and at Reynard Street in the Mission Hills area of San Diego completely away from water.

Dr. Miller wrote that this species had not previously been reported from the San Diego area. (The type specimens had been collected at Santo Tomás, Baja California, Mexico.) He dissected an adult specimen from those found at Wabash Creek and compared its reproductive anatomy with that of a topotype he had collected many years ago. He found them to be "a perfect match and an important new locality for a poorly known species." Dr. Miller added that he was confident that the species exists elsewhere in California but that live animals needed to be collected. The specimens are now in the Santa Barbara Museum of Natural History collection (SBMNH 142889).

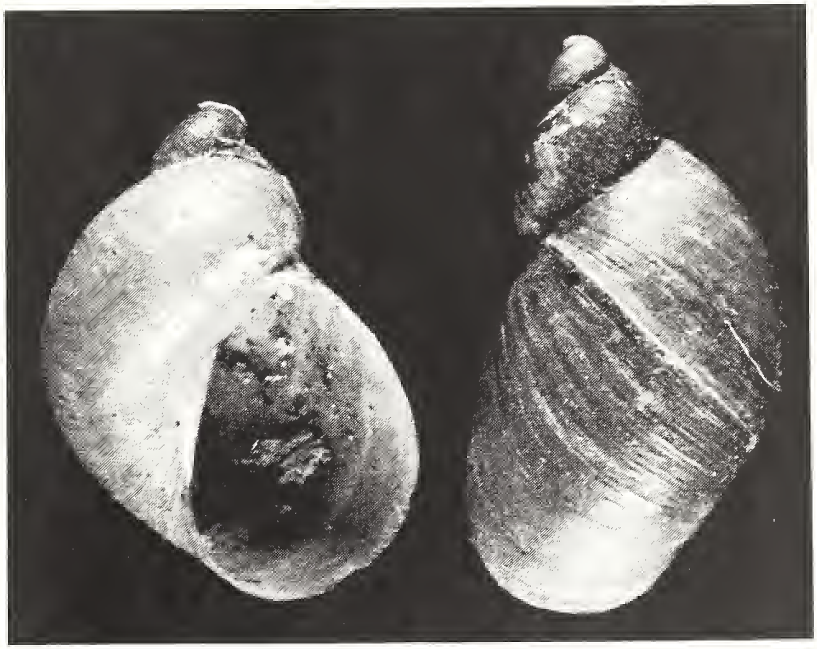

Figure 1. *Succinea californica* Fischer & Crosse, 1878. (SBMNH 142889). Two live-collected specimens, approximately 2 mm each, collected by R. Cerutti, in San Diego, California, at Wabash Creek, East C St. at area where Hwy 94 & I-15 intersect, in dry vernal pools near creek, 16 Jan 1995. Photo: D. K. Mulliner.

ACKNOWLEDGMENTS

My appreciation to Adrienne Russell, of the Education Department of the San Diego Natural History Museum, for bringing these snails to my attention, to Dr. Walter Miller, of the Santa Barbara Museum of Natural History, for identifying the specimens, to David K. Mulliner for the photography of these tiny mollusks and to Carole Hertz who got them identified for me.

BOOK NEWS

Indo-Pacific Coral Reef Field Guide
By: Gerald R. Allen and Roger Steene, 1994
Publisher: Tropical Reef Research, Roley Stone, Western Australia
Paperback. i-v+378 pp., 1800 color photographs
Price: $40.00 + shipping (US priority mail @ $3.00; overseas surface mail @ $6.00 [20% discount for Club members]
Order information:Phone 619-579-8405 or FAX 579-7901

The reef life of the Indo-Pacific is by far the richest assemblage of marine organisms on earth. With the advent of quick and easy travel, SCUBA and live-aboard dive boats, exotic coral reefs are now quickly accessible to anyone with the time and money. To the inquisitive mind, the exposure to this overwhelming diversity of life usually triggers a desire to know the identity of what one is finding. This is particularly true for underwater photographers, who easily can take hundreds of pictures in the course of a short vacation. However, except for guides to the most conspicuous mollusks, corals or fish there has been a dearth of sources available for the identification of all the other groups of reef organisms that often show up in one's viewfinder.

The present identification guide goes a long way to fill this gap for the reef tourist. While it is obviously not exhaustive in illustrating all the taxa one is likely to encounter, I think it succeeds far better than any other guide yet published in showing many of the common species encompassing all groups, from seaweeds to marine mammals. The color photographs are of very good quality. Depending on the size of the subject, views have been taken from a few feet to a few inches away and have diagnostic value for the general identifications one needs in a field guide. Among the 1800 species figured the largest sections are devoted to the corals, crustaceans, mollusks and fish, but all the other major phyla are represented. In addition there is an informative introductory section on the natural history of coral reefs and a brief discussion of taxonomy.

As far as a guide to mollusks is concerned, this work is basic and not meant to be competitive with other sources. Conspicuous species from the major families are presented with about half shown living in their natural habitat and the rest arranged in ten plates of cleaned shells. Again it is meant as a field guide for the reef enthusiast and a good way to be introduced to this amazing habitat. Those in need of more exhaustive treatments of the malacofauna are undoubtedly aware of the expanding supply of Indo-Pacific literature which has extended from "Indo-Pacific Mollusca" and the books by Cernohorsky to the recent two volume set "Australian Marine Shells" from Barry Wilson. The impending arrival of a major work on the shells of eastern Arabia will but add to the coverage for that part of this vast region.

For those interested in a single source of information for the tropical reef, I heartily recommend this work as one which can be included in your travel luggage, with the added bonus of it being useful in sorting out all of your photographs of exotic creatures when you return home.

Henry W. Chaney

[Editor's note: A copy of this publication has been generously donated to the Club library by John Jackson. It will be available for circulation at the next regular meeting.]

ACANTHINA LUGUBRIS FOUND AGAIN IN SAN DIEGO

JULES HERTZ

Santa Barbara Museum of Natural History
2559 Puesta del Sol Road, Santa Barbara, CA 93105, USA

Acanthina lugubris (Sowerby, 1832) has rarely been found in San Diego, California. The species usually occurs on the outer Baja California coast from Magdalena Bay to Rosarito Beach, north of Ensenada, Mexico. I had collected the species at Punta Banda and San Isidro, Baja California in 1968 and 1971 respectively. Radwin (1974) reported on its reappearance in San Diego, and stated that to his knowledge none had been reported in San Diego in 40-50 years prior to 1974. Since then there were no reported sightings until Larry Buck found them in April 1994 on the southern jetty of the Entrance Channel to Mission Bay. Recently, I found specimens intertidally at the north end of Tourmaline Surfing Beach, Pacific Beach, San Diego. One was found on 29 October 1994 and the other on 14 December 1994, both among large rocks at low tide. Again there was a significant period of time (approximately 20 years) between the last appearance of the species and the most recent findings.

The specimen shown in Figure 1 was collected in October 1994 and is 36.0 mm long. The specimen collected in December 1994 is 37.8 mm.

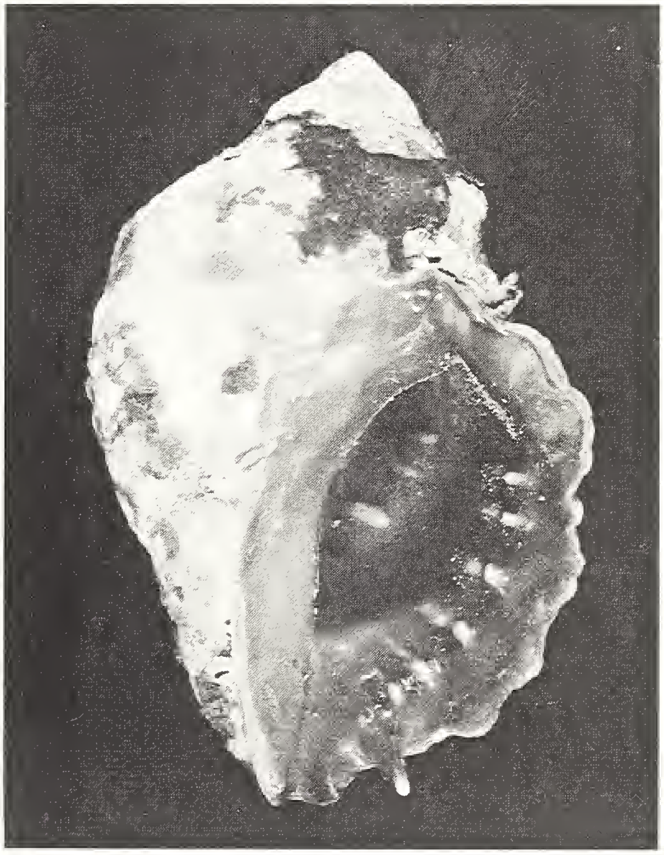

Figure 1. *Acanthina lugubris*, 37.8 mm L, found at Tourmaline Surfing Beach, San Diego, October, 1994. Photo: D. K. Mulliner.

LITERATURE CITED

RADWIN, GEORGE E.
1974. *Acanthina lugubris* reappears in San Diego. The Festivus 5(5):114.

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THE FESTIVUS

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Volume: XXVII October 12, 1995 Number: 10

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Tulane University

Meeting date: third Thursday, 7:30 P.M.
Room 104, Casa Del Prado, Balboa Park

PROGRAM

Shell Repair by *Argonauta* and *Cypraea*

Club member Kent Trego will be the evening's speaker. He will give an illustrated program on the means by which mollusks of two families repair damage to their shells.

Shells of the month: repaired and deformed shells
Meeting date: October 19, 1995

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CLUB NEWS

A Dues Raise for 1996

As can be noted by looking at the masthead (first page of this issue) the new dues rate for 1996 is in effect. Club memberships received after October 1 are automatically considered to be for 1996. Back issues for 1995 can still be ordered at the current rate of $12.00. For 1996, domestic memberships are $15.00, overseas (surface mail) $18.00 and overseas (air mail) $30.00.

The September Party

It was a terrific party! Over 35 Club members had a wonderful time socializing on the Arnold's lovely deck. There was food that just wouldn't quit from the appetizers with wine and soft drinks to the salads, Italian entrees and marvelous desserts. Several people even dressed for the occasion--there were a couple of mafiosos and tourists on the scene.

And then there was the opportunity to look at Terry's fossil mollusk collection and his cowrie collection as well as get some tips from this computer expert.

Marty and Terry Arnold were great hosts and we thank them for making their home and lovely outside area available to the Club for this annual event.

Received for the Club Library

Tom Rice has generously donated two publications to the Club's library. His 19th edition of **A Sheller's Directory of Clubs, Books, Periodicals and Dealers** is a 117 page, spiral bound listing of clubs and shell and book dealers worldwide. Those societies which returned Tom's inquiry forms for this publication received a gift copy. It will be available for circulation to Club members as will his 1995 **A Checklist of Mollusks on Postage Stamps**, fourth edition, for those having the combined hobbies of shells and stamps.

Also, received from **Gloria Maris** is a 20 page, softbound booklet in Belgian entitled **Schelpen op de Belgische Kust** by A. Delsaerdt & L. Steppe (1995, vol. 34[1-2]) with 8 excellent color plates covering the bivalves and gastropods of the area.

Have You Noticed a Difference?

In August your editor received a form letter from the printer we had used for the past twenty years, announcing that its small print division would no longer print **The Festivus**. Their corporation no longer found it profitable to do "small runs" such as ours.

After much "shopping around," a new company, DPI (Demand Printing Inc.), was found which first published **The Festivus** with the September issue. They are using the latest technology (no ink, no paste-ups) and automatically collating and stapling the issues. Photographs are now scanned directly from the originals (no more half tones to make up) and can be sized to fit the space desired. Color xerography for plates can be done there as well. What do you think?

More on Books

Of Sea and Shore Publications announces the publication of Henry Close's **Lure of the Liguus: The Florida Tree Snails**. The spiral bound book has 140+ (8½ x 11) pages with color cover and three color plates illustrating over three dozen shells. Included are 30 full-page black and white plates, 15 maps, 21 tables, and 8 text figures. Order from Of Sea & Shore Publications, P.O. Box 219, Port Gamble, WA 98364-0219 @ $19.95 + $3.00 postage (domestic). Additional postage costs for other areas.

Mark Your Calendar

The next big Club social event will be the Christmas Dinner Party on Saturday evening, December 2nd at the Sheraton Inn San Diego Central (near Montgomery Field). There will be further information in the November issue as well as an announcement at the Club meeting.

New Members

Baker, Dixie, 1256 Felspar St., San Diego, CA 92109. (619) 483-5463

Hayes, Brian, P.O. Box 804, Port Elizabeth, 6000 South Africa. Phone or FAX 0027-41-334521

PACIFIC PANAMA RECORDS FOR THE CARIBBEAN SPECIES *CONUS MUS* HWASS, *IN* BRUGUIÈRE, 1792 (GASTROPODA: CONIDAE)

WILLIAM K. EMERSON

American Museum of Natural History, Central Park West at 79th Street, New York,
New York, 10024-5192, USA

INTRODUCTION

In the process of reviewing the distribution of the species of *Conus* living in the eastern Pacific Ocean, I encountered a report of several specimens of the western Atlantic species, *Conus mus* Hwass, *in* Bruguière, 1792, occurring on the west coast of Panama (Burch, 1960a, b). Most subsequent workers have not accepted *Conus mus* as a west American faunal constituent (e.g. Hanna, 1963; Keen, 1971; Walls, 1979; Kohn, 1992:89). An exception is Abbott (1974:256), who mentioned that *Conus mus* had apparently been introduced to the Pacific side of the Panama Canal Zone, citing Burch (1960b).

Inasmuch as *Conus mus* is generally considered to be a cognate of the eastern Pacific *Conus gladiator* Broderip, 1833 (Hanna, 1963:7; Old, 1976:52; Vermeij, 1978:224), I have undertaken to determine the authenticity of the literature citations of Burch (1960a, b), as well as to search for museum records of *Conus mus* from Pacific Panama and elsewhere in the west American tropics.

MATERIALS and METHODS

This paper is based on a review of the literature and the examination of specimens from the collections listed below. In addition to institutional collections, several private collectors were consulted regarding their holdings (see acknowledgments). The curators of the following institutions were asked to check their collections for eastern Pacific records of *Conus mus*. The abbreviations listed accompany cited specimens in the text and figures: AMNH, American Museum of Natural History, New York; ANSP, Academy of Natural Sciences of Philadelphia, Pennsylvania; CASIZ, California Academy of Sciences, San Francisco; DMNH, Delaware Museum of Natural History, Wilmington; FMNH, Florida Museum of Natural History, Gainesville; LACM, Los Angeles County Museum of Natural History, California; MCZ, Museum of Comparative Zoology, Harvard University, Massachusetts; SBMNH, Santa Barbara Museum of Natural History, California; and USNM, National Museum of Natural History (U. S. National Museum collection), Smithsonian Institution, Washington, D. C.

RESULTS

Burch (1960b:81, 82) proposed that the well-known Caribbean species *Conus mus* (Figures 1-6) be added to the fauna of the eastern Pacific Ocean. This suggestion was based on specimens he had received on numerous occasions from Panama Bay (Golfo de Panamá) mixed with the closely related *Conus gladiator* (Figures 7, 8), a species that is distributed from Baja California, Mexico south to Ecuador (Keen, 1971:661). Burch previously had been reluctant to confirm the Pacific presence of *C. mus* until he obtained definite collecting data. He was able to verify specimens collected in March 1960 by Harris P. Dawson, Jr. "...from Panama Bay, under rocks at lowest tide off Veracruz village beach" near the western entrance of the Panama Canal. *Conus mus*, a widespread species in the Caribbean, from southeastern Florida to Trinidad (Walls, 1979:751), occurs on the eastern coast of Panama where it is reported from Payardi Island (Isla Payardi) (Radwin, 1969:235) and Colon Island (Isla de Colón) (Olsson & McGinty, 1958:17).

The present investigation has confirmed the identity of three lots of *C. mus* collected from Veracruz Beach, Panama Province (9° 09'N, 80° 11'W) by H. P. Dawson, Jr. in April 1960. The first lot consists of 4 beach specimens (LACM 121788; ex-Burch Collection). The second lot with the same locality data contains 1 beach specimen (Figures 3, 4) (AMNH 148095; ex-Burch Collection). The third lot from "Vera Cruz [sic] Village, Panama, Harris Dawson Collection, 1959-1960" contains 1 well-preserved beach specimen (CASIZ 102564; ex Burch Collection). Another lot from Veracruz Beach from "H. P. Dawson, 1959" (LACM 121210; ex Burch Collection) consists of a small specimen with the periostracum largely intact labeled "*Conus mus* Hwass, 1792." It is, however, actually referable to *Conus gladiator*.

Additionally, the identity of three lots of *Conus mus* each containing one specimen was confirmed from Taboga Island (Isla Taboga; 8°47'N, 79°33'W), near the Pacific entry to the Panama Canal. Specimens of two of these lots have the periostracum largely preserved. The original labels, identically typed, accompanying the two lots, read: "Taboga Id. Panama, Jas. Zetek Leg. 1935" (Figures 5, 6) (AMNH 189826; ex Gordon Nowell-Usticke Collection; LACM 121373, ex Burch Collection). Both specimens are numbered 1645, which may represent Zetek's original registration number. The third lot is labeled "Isla Taboga, Panama, Dawson, 1956" (Figures 1, 2) (LACM 47724, ex Burch Collection).

Two beach worn specimens of *Conus mus* and one *Conus gladiator* were also found mixed in a lot from Culebra Bay (Bahiá de Culebra), Costa Rica (10°37'N, 85°40'W) (DMNH 9270, ex Warner R. Oliver Collection). It seems prudent to reject this lot from an old collection unless additional records of *Conus mus* from Costa Rica can be verified. Lots in museums containing *Conus mus* mixed with *Conus gladiator* and/or *C. purpurascens* Sowerby, 1835, a species distributed from the Gulf of California, Mexico to Ecuador (Keen, 1971:664), should not be unexpected in old collections (e.g. AMNH 25142; ex D. J. Steward Collection, labeled only from "Panama").

CONCLUSIONS

There seems no reason to question the authenticity of the records of Dawson and Zetek. James Zetek (1886-1959) was a well-known invertebrate zoologist who specialized in termites and mollusks. He resided most of his life in Panama and served from 1923 to 1958 as Resident Manager of the Canal Zone Biological Area, Barro Colorado, Lake Gatun (Baker and Jadis, 1960:158). I have been able to find little information regarding Harris P. Dawson, Jr. other than he was an active field collector (*teste* Tanya Kausch, *in litt.* May 2, 1995). The professional correspondence of John Q. Burch (1894-1974) was destroyed in 1989 and no additional data are available regarding Dawson's specimens (B. L. Burch, *in litt.* April 30, 1995). The John Q. and Rose A. Burch Collection of *Conus* was deposited in the LACM (*teste* B. L. Burch, *in litt.* March 16, 1995).

It seems probable that the Pacific Panama records of *Conus mus* represent transitory faunal elements that did not establish reproductively viable populations in Panama Bay. Perhaps this species was introduced into these waters by the discharge of larvae from ballast tanks of ships that had departed from tropical Atlantic waters, traveled the Panama Canal, and entered into the Pacific Ocean. Both Veracruz Beach and Taboga Island are adjacent to the Pacific entrance of the Panama Canal. Recent extensive collecting in western Panamic waters has not revealed the presence of *Conus mus* (*teste* Royce Hubert and James Ernest, *in litt.*, April 5, 1995). Futhermore, no other records in the literature or in museum or private collections were found recording *Conus mus* from the eastern Pacific Ocean. Therefore, *Conus mus* is here rejected as an established constituent of the eastern Pacific fauna.

ACKNOWLEDGMENTS

I am pleased to acknowledge with thanks the cooperation of a number of people for their aid in the completion of this paper. Information was provided by Elizabeth Kools (CASIZ), James H. McLean (LACM), Carol Skoglund (Phoenix, AZ), Kurt Auffenberg (FMNH), Gary Rosenberg (ANSP), Paula M. Mikkelsen and Betty Jean Piech (DMNH), Tanya Kausch (MCZ), Beatrice L. Burch (Kailua, HI), Royce E. Hubert and James Ernest (Panama), Henry W. Chaney (SBMNH), Alan Kabat (USNM), Helen DuShane (Whittier, CA) and Donald R. Shasky (Oceanside, CA). I am also indebted to my AMNH colleagues Andrew S. Modell, for photographic services, Stephanie Crooms, for word-processing the manuscript, and the late Walter E. Sage, III, for technical assistance.

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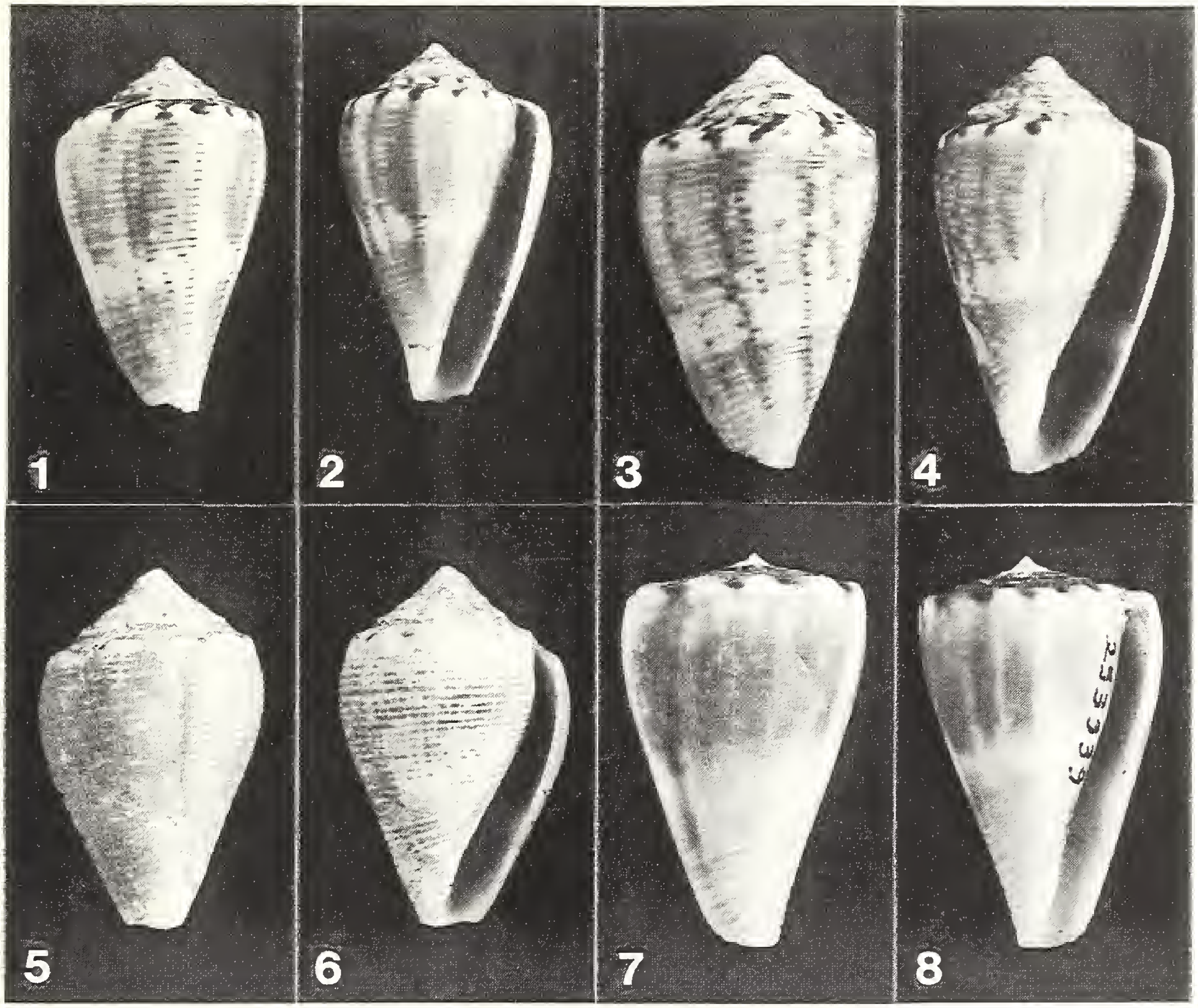

Figures 1-6. *Conus mus* from Pacific Panama. Figures 1, 2, Taboga Island (LACM 47724); Figures 3, 4, Veracruz Beach (AMNH 148095); Figures 5, 6, Taboga Island (AMNH 189826). Figures 7, 8, *Conus gladiator*, Venado Island, Gulf of Panama (AMNH 253939, ex Helen DuShane Collection). All figures X2.

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SHASKY'S SECRET (FINDING *COLUBRARIA PROCERA)*

DONALD R. SHASKY

4990 Nighthawk Way, Oceanside, California, USA

In the April issue of **The Festivus**, Michael Small wanted to know if any of the readers of **The Festivus** had ever collected live specimens of *Colubraria procera* (Sowerby, 1832). Yes, Michael, there is at least one...me.

For three weeks, in both 1978 and 1979, I was a diver for an Ecuadorian archaeological expedition at La Plata Island which is 25 miles off Puerto Lopez. My job was to determine if *Spondylus princeps* Broderip, 1832, was still to be found in the waters surrounding the island (see Shasky, 1980). *S. princeps* had great monetary value for the pre-Columbian Indians. Since this has nothing to do with Small's question, I will return to the main topic.

On June 19, 1979, I had my first opportunity to have the dive boat to myself. Numbers of times our boat had passed over an area that no one else was interested in exploring and now was my chance. This reef bottomed out at 12 meters. It was composed of large flat rocks that were covering masses of silt. There was little to find under the slabs so I began to fan the silt (which raised large clouds of the stuff). After I had fanned about two inches off the top, out popped a fine *Colubraria lucasensis* Strong & Hertlein, 1939. This was the first one of these that I had collected in many years.

I continued to fan for what I hoped wiould be its mate. After fanning off about another four inches of silt, just waiting to be possessed was my first *C. procera*. What an adrenalin rush!!

The next day, at the same place and under the same conditions I found two more (Figure 1). I was feasting on adrenalin. Eat your heart out, Michael.

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SMALL, MICHAEL

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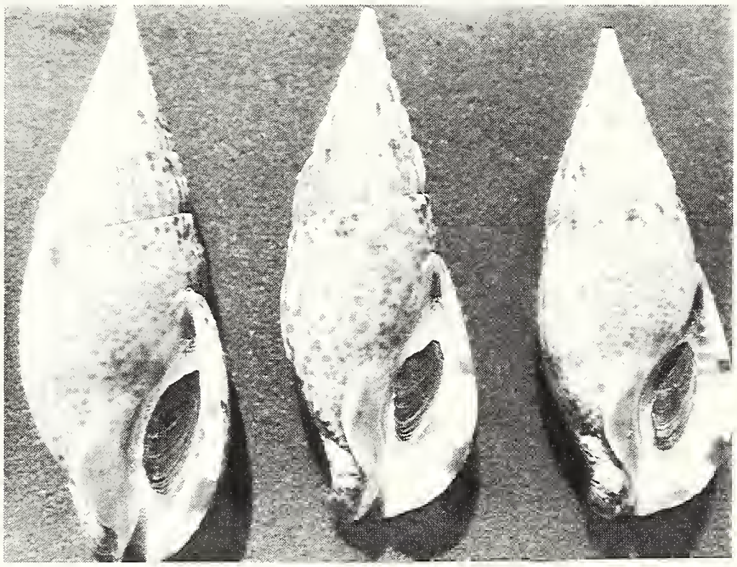

Figure 1. *Colubraria procera* (Sowerby, 1832), 3 specimens. Left-right, 80.3, 73.6, and 71.1 mm L. Leg. D. R. Shasky, 19 June 1979.

"PURPLE POPCORN CORAL" AN INTERESTING AND UNUSUAL SUBSTRATE

LARRY BUCK

13440 Portofino Drive, Del Mar, California 92014, USA

"Purple Popcorn Coral" -- sound like candy? Actually it's the name Kim Hutsell coined for an interesting and unusual undersea substrate he discovered a number of years ago adjacent to a popular camping area in Bahía Concepción, Baja California Sur, Mexico. This area is one of the richest in molluscan life that we've encountered in the Sea of Cortez.

The "Purple Popcorn Corals" are rhodoliths, a term meaning red stones and are a type of coralline algae. When asked for help in identifying these algae, Ron McPeak sent the photos of the rhodoliths (Figures 1 and 2) to Diana Stiller of Hopkins Marine Station who identified them. Diana Stiller had worked on these algae in Bahía Concepción. The many small spheres are *Lithothamnion australe* (Figure 1) and the flat-branched, leafy one is either *Lithophyllum veleroae* or *L. diguetii* (Figure 2).

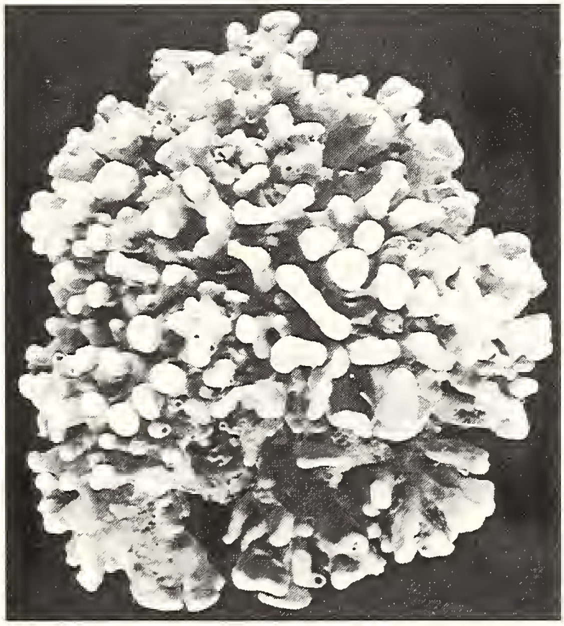

Figure 1. *Lithothamnion australe*. Approximate diameter at base: 40 mm. Photo: D. K. Mulliner.

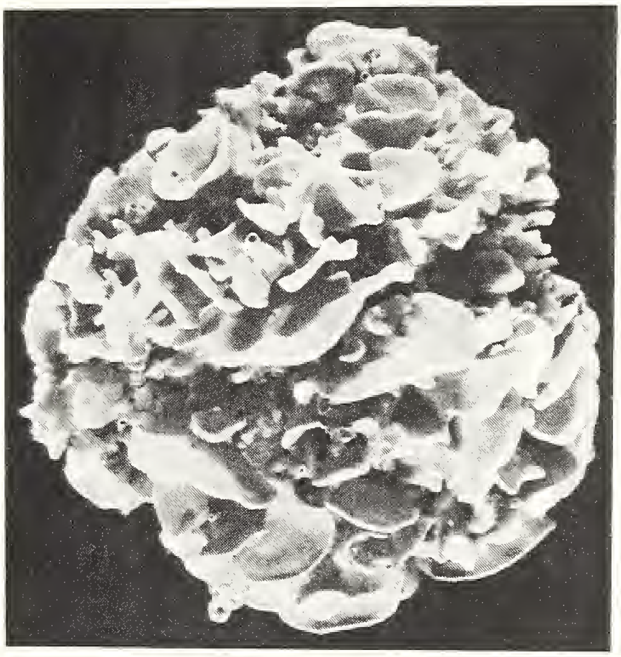

Figure 2. *Lithophyllum veleroae* or *L. diguetii*. Approximate diameter at base: 40 mm. Photo: D. K. Mulliner.

The layer of rhodoliths can cover the sea bottom to a depth of 12 to 18 inches. The area is found at a depth of 20 to 35 feet in sunlit waters with good tidal exchange. I've put my hands down into the surface of this layer and scooped up many little balls with the consistency and look of popcorn. Down six to twelve inches into the rhodoliths, its loose consistency is composed of broken fragments. These colonies appear to grow in cycles. I've compared samples from several consecutive years and noticed the "balls" (rhodolith clumps) increasing in size each year. Their gradual disintegration seems to lay a foundation for the next cycle.

Many mollusks inhabit this niche. Many bivalve species live in and under the "Purple Popcorn Coral." Some grow uniquely here like the various unattached *Chama* and *Spondylus* species which lack their usual large area of attachment. When I first saw *Spondylus calcifer* Carpenter, 1857, from this habitat, I wondered if it was another species. It was that different from those I had seen before from other areas. It's common here to see dead valves of huge *Megapitaria aurantiaca* (Sowerby, 1831), providing cover for egg-laying of the area's dwarfed *Cypraea annettae* Dall, 1909.

I've always noticed the large muricids, *Hexaplex nigritus* (Philippi, 1845), and *Chicoreus erythrostomus* (Swainson, 1831), preying on bivalves and breeding there. Maybe because I've paid so much attention to the area, I've particularly noticed population density--abundance and dieoffs--in many of the mollusks in the area. I don't know if this is in any way related to the substrate.

This unique habitat, with its rich molluscan life, offers an opportunity for study and prolonged monitoring of the area. I am curious about what factors influence the occurrence and duration of the cycles mentioned earlier. I'll be reporting more on this phenomonon in the future as I make and record more field observations.

My thanks to Dave Mulliner for photographing my specimens, to Kim Hutsell for sharing his discoveries with his friends, to Ron McPeak for arranging to have the species identified, and to Diana Stiller for the species identifications.

TWO DONATIONS TO THE SAN DIEGO SHELL CLUB

Two very generous donations were made to the San Diego Shell Club to benefit special projects of **The Festivus**. They were made by member Forrest L. Poorman of Westminster and former member Laura Shy of Seal Beach, both in California.

Laura Shy donated library material which includes twelve years of the **The Veliger** and a large selection of periodicals and reprints. Included in these is a complete, unbound set of Berry's **Leaflets in Malacology**.

Forrest Poorman donated most of the Leroy and Forrest Poorman Library of molluscan books, periodicals and reprints built by the Poormans over their many years of involvment in malacology as collectors and authors as well as in describing species new to the science.

Among the books donated are Keen's **Sea Shells of Tropical West America** both first and second editions, Oldroyd's complete **The Marine Shells of the West Coast of North America**, softbound, and Radwin & D'Attilio's **Murex Shells of the World an Illustrated Guide to the Muricidae** autographed by the authors and photographer.

A very large selection of reprints of Panamic literature is included in the Poorman material along with issues of molluscan periodicals.

These donations were made with the understanding that they would be used by the Club as best befit its interests. Literature which will add to the Club library holdings, will be made available to members in the Club's fine circulating library. Some duplicate books, journals and reprints will be auctioned at the Club's annual Auction/Potluck in April and other reprints will be placed for sale at various reprint sales held on regular meeting dates throughout the year.

The Club thanks Mmes. Forrest Poorman and Laura Shy for their very generous donations to the San Diego Shell Club and its publication, **The Festivus.**

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THE FESTIVUS

A publication of the San Diego Shell Club

Volume: XXVII November 9, 1995 Number: 11

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SMITHSONIAN
1995
LIBRARIES

Meeting date: third Thursday, 7:30 PM
Room 104, Casa Del Prado, Balboa Park

PROGRAM

Returning to the Central Solomons

Dr. Henry W. Chaney of the Santa Barbara Museum of Natural History just returned from a trip to the Solomon Islands. He will give a slide program highlighting the area and its molluscan life.

Meeting date: November 16, 1995
Shells of the month: Solomon Island area shells

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CLUB NEWS

The Annual Christmas Dinner Party

This year the Club Christmas party will be held on Saturday evening, December 2nd in the Montfield Room of the Four Points Sheraton Inn at 8110 Aero Drive in San Diego (near Montgomery Field). The festivities will begin at 6:00 p.m. with no-host cocktails and be followed by a sit-down dinner at 7:00 p.m.

The menu consists of Caesar salad, rolls and butter, entree with baked potato and fresh vegetable, cheese cake and coffee or tea. The entree choices are: Chicken marsala (boneless breast served with Marsala wine sauce) or Roast loin of pork (with cinnamon apple dressing and pork demiglaze gravy). A vegetarian selection is also available. The Club, as always, will provide the dinner wine. The cost of the evening is $22.50 per person, including tax and gratuity.

The deadline for reservations is November 25th. Please send your check (with entree choice(s)) to the Club address or bring to the November meeting.

For those who plan to attend, remember to bring your gift-wrapped shell to place under the tree for the traditional gift exchange. List only general locale on the outside of the package i.e. Indo-Pacific, eastern Pacific. Only those who bring a gift-wrapped shell can participate in this enjoyable tradition.

Also, bring slides of some event or events of the past year to share as part of the evening program. And most of all, don't forget to be a part of the Club Christmas party. It's always a very happy occasion.

From the Minutes of the Meeting of the San Diego Shell Club, October 19, 1995

President Kay Klaus opened the meeting at 7:35 p.m. She announced that the membership dues will be increased for the coming year [see masthead]. Kay invited everyone to the Christmas party [see notice this page]. Jules announced a special holiday sale on tee shirts and sweatshirts [see notice, this page].

The nominating committee presented the following slate of officers for next year's Board: Bill Romer, President; Terry Arnold, Vice President; Margaret Mulliner, Treasurer; Silvana Vollero, Recording Secretary and Kim Hutsell, Corresponding Secretary. Nominations from the floor will be entertained at the November meeting followed by the election of officers.

Kim introduced the speaker for the evening, Kent Trego, who showed some fascinating slides of *Argonauta* and *Cypraea* that had been repaired and discussed what is known about this process. He suggested that there is much research to be done on this topic. Many interesting questions were posed by those in attendance.

Kay presented the idea for a new Club event. Beginning on November 4th, Club members are invited to Kay's house the the first Saturday of the month at 2:00 p.m. to just talk shells [see notice, this page].

Carole Hertz announced that she and Jules are working on a 30 page, 26 year index of **The Festivus** to be available free to all renewing members that mark that they would like a copy on their renewal forms.

Wes Farmer shared with everyone a book of his photos and other materials on the geology of the Torrey Pines Reserve, including various fossil specimens.

The winner of the drawing was Linda Hutsell. Unfortunately, Linda was not able to keep the nice treasure chest that housed her prizes. The meeting was adjourned at 8:40 p.m. to enjoy the refreshments (brought by Marge Bradner and Larry Catarius) and talk and view our favorite things, shells.

Silvana Vollero

The Holiday Tee Shirt Sale

For the November meeting only, Club tee shirts and sweatshirts will be on sale at rock-bottom prices for those who would like to give them as holiday gifts. This is a one-time-only offer and only available at the November meeting. Come and get 'em!

Saturdays at Kay's House

Kay Klaus has generously offered to make her home available the first Saturday of each month [except December] to any Club members who would like to come to "talk shells." The "Saturdays at Kay's House" will be very informal, with topics to be discussed decided by those in attendance on each Saturday.

If you are interested in attending the next get-together on Saturday, January 6th, please let Kay know you are coming by phoning her at (619) 292-4527.

PARASITISM OF SLEEPING FISH BY GASTROPOD MOLLUSKS IN THE COLUBRARIIDAE AND MARGINELLIDAE AT KWAJALEIN, MARSHALL ISLANDS

Scott Johnson[1], Jeanette Johnson[1] & Stan Jazwinski[2]

Abstract

Six species of the family Colubrariidae and two species of Marginellidae in the Marshall Islands feed by parasitizing sleeping fish, especially species of Scaridae. Feeding in colubrariids is similar to that described for *Cancellaria cooperi* by O'Sullivan *et al.* (1987), and feeding in marginellids matches that of Bouchet (1989) reported from New Caledonia.

Introduction

This study was undertaken after we noticed that *Colubraria tortuosa* (Reeve, 1844) could often be observed at night in the vicinity of sleeping parrotfish (family Scaridae). Further examination revealed that six of seven species in the caenogastropod molluscan family Colubrariidae known from Kwajalein and at least two species of Marginellidae parasitize scarids and, occasionally, other fish sleeping on the steep oceanside dropoff of Kwajalein Atoll, Marshall Islands.

Parasitism of fish by gastropod mollusks has been reported twice in the past few years. O'Sullivan *et al.* (1987) reported *Cancellaria cooperi* Gabb sucking blood from the ray *Torpedo californica* Ayres in California. More recently, Bouchet (1989) reported two species of Marginellidae from New Caledonia feeding on body fluids of sleeping fish at night.

Methods

Initial observations of gastropods parasitizing sleeping fish were made at night on the steep leeward oceanside dropoff on the west side of the southern portion of Kwajalein Atoll. In this area, the water gradually deepens from the island or inter-island intertidal reef to a depth of 3 to 6 meters at the seaward edge of the reef front. At this point, the reef abruptly drops off in a wall that ranges in slope from 60 to 90 degrees, and is even undercut in places. The reef face on the dropoff and in occasional "surge channels" - 3 to 10 meter wide, 10 to 20 meter deep, 5 to 30 meter long cuts in the reef perpendicular to the reef front that usually intersect the dropoff - is pocketed with numerous caves and holes that provide convenient sleeping sites for scarids and other fish at night.

Over six years, scarid/parasite relationships were monitored during regular night dives. Several dives were made specifically to count scarids with and without parasitic gastropods.

Colubrariid and marginellid species found parasitizing sleeping fish at night were sought out during the day to determine diurnal habits.

Buccal anatomy of colubrariids was examined in an attempt to determine how feeding occurs.

Results and Observations

Colubrariids

Specimens of six colubrariid species found at night are strongly associated with sleeping fish (Table 1). Nearly all of the host fish are several species of Scaridae. The six distinctly parasitic colubrariids are *Colubraria tortuosa*, *C. nitidula* (Sowerby, 1833), *Colubraria muricata* (Lightfoot, 1786), *C. obscura* (Reeve, 1844), *C. aff. obscura*[3] and *C. castanea* Kuroda *in* Habe, 1961. Actual feeding on sleeping fish (described below) has been observed in all six. Furthermore, all or nearly all specimens of five species, when observed at night, are either feeding on or within a meter of a sleeping scarid. *Colubraria muricata* (Lightfoot, 1786) was found under sleeping scarids on five out of thirteen occasions.

One other colubrariid at Kwajalein, *Colubraria clathratus* (Sowerby, 1833) is never found associated

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[1] Box 325, APO AP 96555
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[3] This unidentified species is similar to, but distinct from, our other *Colubraria obscura*.

with sleeping fish. This nocturnal species is commonly found at night crawling along the walls or ceilings of small dropoff or surge channel caves. Feeding habits of *C. clathratus* are unknown.

A parasitic colubrariid feeds by first approaching a sleeping fish. (See Figures 1-5.) If the fish is a scarid encased in a mucus bag, the colubrariid can either squeeze through the bag or remain outside; small colubrariids have even been observed crawling on the mucus bag itself. (Most mollusk parasitism has been observed on adult scarids, which, as noted by Hobson (1965), usually do not form complete mucus sleeping bags.) The colubrariid extends its long proboscis, which can stretch three or more times as long as the mollusk's shell. (The maximum shell size for *C. tortuosa* is about 66 mm; for *C. nitidula* about 35 mm.) The proboscis often enters the scarid through the anal opening, the mouth, the gill opening or the eye socket, but it also can be simply slid beneath a body scale. Presumably, the mollusk has a means of breaking through the scarid's flesh, and blood or other body fluids are sucked up through the elongated proboscis. Searches for radulae in *C. tortuosa* and *C. nitidula* were unsuccessful.

Both *C. tortuosa* and *C. nitidula* are usually found in groups of two or more individuals. The most *C. tortuosa* individuals ever found on a single host scarid is five. Nine *C. nitidula* have been observed on a single host, and the maximum numbers of individuals of *C. aff. obscura*, *C. obscura*, *C. castanea* and *C. muricata* found with one host are two, one, one, and one respectively. In several instances, both *C. tortuosa* and *C. nitidula* were found parasitizing a single fish at the same time.

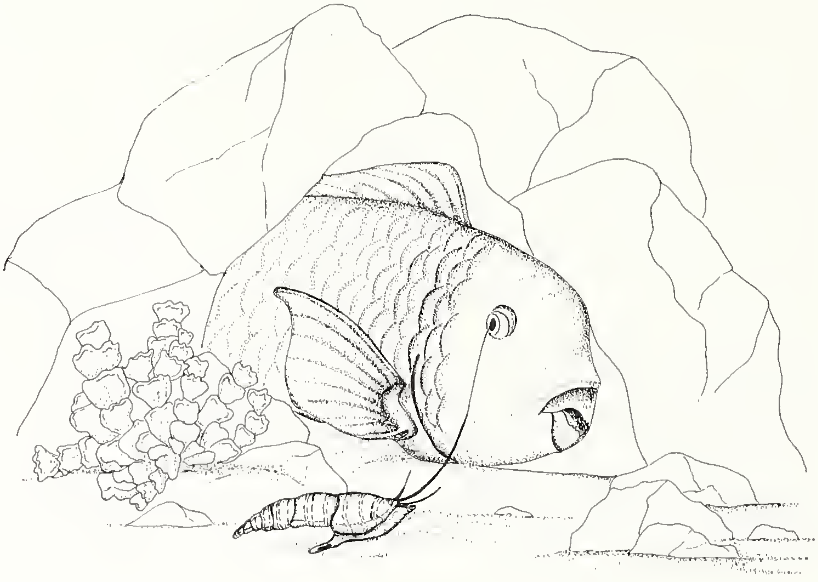


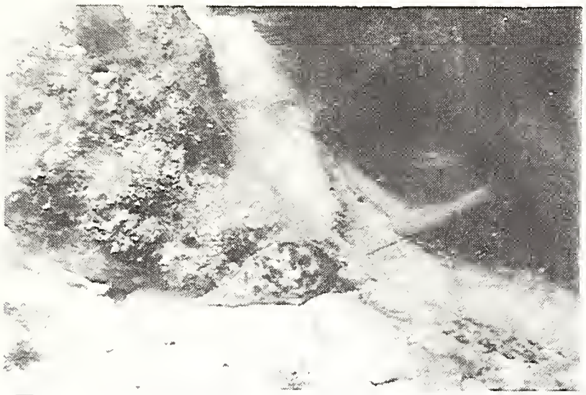
Figure 1. *Colubraria tortuosa* with feeding proboscis extended into the eye socket of a sleeping scarid.

During the day, all colubrariid species are usually inactive and remain secreted beneath rocks or in piles of dead coral rubble that collect on the dropoff wherever it is flat enough (often on floors of or in front of the small caves and ledges where scarids sleep at night). Some, such as *C. muricata*, *C. obscura* and *C. nitidula*, also bury in sand within the caves. Groups of three or more *Colubraria nitidula* are frequently found under rocks that rest on sand or sandy rubble.

We have observed two cases of colubrariids actively feeding during the day. In one instance, a group of nine *C. nitidula* was actively parasitizing a sleeping nocturnal fish, *Priacanthus* sp., at midday. The fish was resting in a relatively narrow sandy-bottom ledge. The *C. nitidula* had emerged from the sand (in most specimens, only the anterior whorl of the shell protruded from the sand), and each had extended its proboscis 8 to 10 cm upward into the ventral surface of the sleeping fish. In the other case, a single *C. castanea* was observed partly buried next to what appeared to be a rubble pile in a small sandy hole in the reef. When pulled from the sand, the snail retracted its long brown proboscis, which extends only when the animal is feeding. A close examination of the hole revealed that the "rubble pile" the snail was nestled up against was in fact its prey: a stonefish, *Synanceja verrucosa* Bloch & Schneider, 1801, buried up to its eyeballs in the sand.

Marginellids

One of the marginellid species found on sleeping fish has been tentatively identified as *Kogomea ovata* Habe, 1951; the other resembles the parasitic *Hydroginella caledonica* (Jousseaume, 1876) reported by Bouchet (1989) but is only about one third its size. At least four other small



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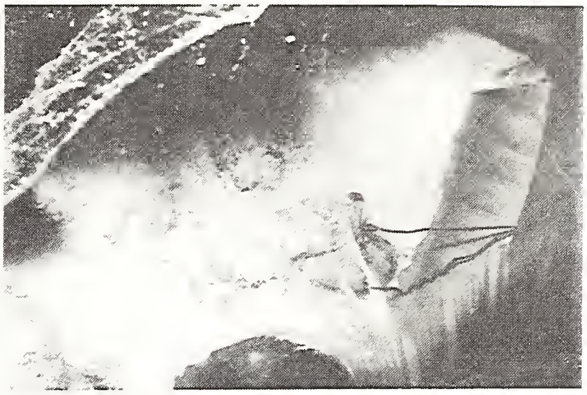

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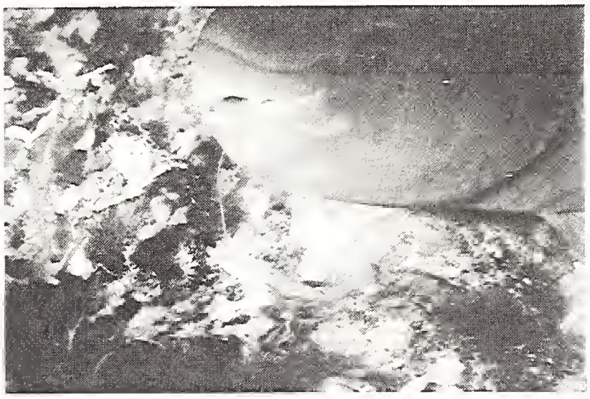

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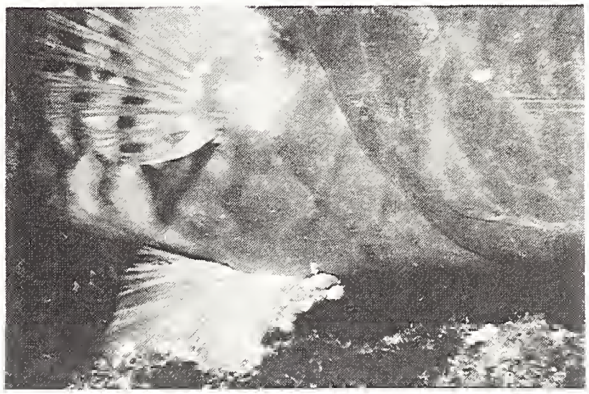

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Figures 2-7. (2) *Colubraria tortuosa* with feeding proboscis extended into the underside of a sleeping scarid.
(3) Pair of *Colubraria tortuosa* with probosces extended into the anus of a sleeping scarid through its mucus bag (the mollusks are under and outside of the bag).
(4) Small *Colubraria tortuosa* crawling on the outside of an invisible mucus bag.
(5) *Colubraria nitidula* with white proboscis extended into the mouth of a sleeping scarid.
(6) Several *Kogomea ovata* on the dorsal fin of a sleeping scarid.
(7) Cluster of *Kogomea ovata* just in front of the pelvic fin of a sleeping scarid.

marginellids from Kwajalein appear not to parasitize sleeping fish.

Initially, we thought that the marginellids could be simply feeding on body mucus. However, when we attempted to carefully remove specimens from a sleeping scarid's body, we noticed the proboscis extended into the host's flesh. The marginellids sometimes adhere well enough, in fact, to remain attached to a scarid that is disturbed into leaving its sleeping spot. Disturbed scarids dart quickly away, often running into coralheads with enough force to lose scales. The marginellids need to be firmly attached to remain on the fish when this happens.

Kogomea ovata are often found in groups. Up to 28 individuals have been found on a single host scarid (Figures 6-7). Frequently, they cluster into small "balls" of 10 to 15 shells, especially on or around a host's fins. In one case, about 18 individuals were seen crawling on a scarid's face, leaving criss-crossing mucus trails to which fine sand was sticking.

During the day, *K. ovata* lives, also usually in groups, under rocks and in piles of dead coral rubble, and is apparently inactive. In one case, over 50 individuals were found clustered together under a large rock; once exposed to sunlight, they began to crawl rapidly away. The second parasitic marginellid is rare and has not been found during the day.

Hosts

Colubrariids and marginellids parasitize most of the large species of scarids on the reef, including *Scarus rubroviolaceus* (Bleeker, 1849), *S. altipinnis* (Steindachner, 1879), *S. festivus* Valenciennes, 1840, *S. gibbus* Rüppell, 1828, and others. *Cetoscarus bicolor* (Rüppell, 1829), although very common on the reef, seems to be parasitized less often. Whether this species' protection is due to tougher skin, more sensitivity to disturbances by the parasites, or simply gastropod choice is unknown.

The percentage of the adult scarids on the leeward reef that appear to have parasites varies from night to night or site to site (Table 2). (The numbers are under-reported since few sleeping scarids could be examined on all sides for the often small mollusks.)

Observations of sleeping fish on lagoon reefs have so far yielded no parasitism by *Colubraria* spp., although living and dead shells of *C. muricata, C. nitidula*, and *C. tortuosa* are occasionally found on those reefs during the day. Parasitism on sleeping scarids by *Kogomea ovata* has been observed at night on lagoon pinnacles.

Other fish occasionally subject to parasitism on seaward reefs include species in the families Acanthuridae, Serranidae, Balistidae, Scorpaenidae and Priacanthidae. Parasitism within these families is rare. On one occasion each, *Colubraria tortuosa* was observed parasitizing *Acanthurus pyroferus* Kittlitz, 1834, *Naso lituratus* (Bloch & Schneider, 1801), *Cephalopholis argus* (Schneider, 1801), *Balistoides viridescens* (Bloch & Schneider, 1801) and *Scorpaenopsis diabolus* (Cuvier, 1829). A single instance of nine *C. nitidula* parasitizing a sleeping *Priacanthus* sp. during the day is described above, as is an observation of one *C. castanea* on a *Synanceja verrucosa*.

Discussion

Feeding habits of species of *Colubraria* have not previously been reported. Taylor (1987) found no identifiable remains in the stomach of *C. reticulata* (Blainville, 1826), which might indicate it is also parasitic. An individual that feeds on blood and body fluids would not be expected to have anything readily identifiable in its stomach.

Parasitism by *Colubraria* and marginellids typically occurs at night. However, the observation of two instances of parasitism in the middle of the day indicates that the mollusks' nocturnal activity is probably due more to the limited availability of motionless fish within reach during the day.

O'Sullivan *et al.* (1987) showed that *Cancellaria cooperi* locates host fish by chemosensory means. It is likely the same holds true for *Colubraria* and marginellids. Sleeping scarids are abundant in small holes and on ledges on the oceanside reefs of Kwajalein. Most *Colubraria* and marginellid individuals live either in those same holes or in piles of dead coral rubble on the floor of or just outside the holes. Since virtually all active parasitic *Colubraria* and marginellids observed at night are on or adjacent to sleeping fish, the parasites might remain inactive and hidden unless a host is within sensing distance. Even colubrariids buried in sand appear to be able to detect the presence of sleeping fish. The nine *C. nitidula* feeding on the sleeping *Priacanthus* during the day were still mostly buried in sand when observed. They apparently detected the fish above them, and emerged just enough to extend their probosces into the host.

Parasitic feeding in *Colubraria* spp. is similar to that reported by O'Sullivan *et al.* (1987) for *Cancellaria cooperi* in that the snail's proboscis is often extended into an area of the host with thin, easily penetrated skin (e.g., mouth, eye, gill opening, anus). When not feeding from such an "internal" part of the prey, *C. cooperi* makes small cuts with a piercing radular tooth on a ray's ventral surface; a species of *Colubraria*, on the other hand, squeezes its proboscis under a parrotfish's large, thick scales and presumably cuts through the skin there.

How *Colubraria* breaks through the skin of a sleeping fish is unknown. We were unable to find radulae in several specimens of *Colubraria nitidula* and *C. tortuosa*. Some publications (e.g., Springsteen & Leobrera, 1986) have stated that members of the Colubrariidae lack a radular ribbon. Ponder (1973), on the other hand, indicates that the radula is vestigial. It is conceivable that a minute, apparently vestigial ribbon of single teeth (which might be difficult to find if present) would be sufficient to cut through thin skin and allow the proboscis access to the fish's blood. The proboscis wall is muscular, indicating that feeding is suctorial.

Ponder (1973) also notes the presence of a glandular esophagus wall in colubrariids. The glands might produce an anesthetic to keep from disturbing the sleeping fish or, if no radula is present, produce substances that chemically break through the skin.

Probably the best defense a scarid has against colubrariid parasites is its tendency to dart away at the least disturbance, leaving behind all colubrariids (which often get buried in a cloud of silt). An anesthetic used by a colubrariid to mask its entry through the fish's skin would almost certainly be advantageous. However, it is uncertain if the sleeping fish are sensitive to disturbances under natural conditions, or if their observed edginess is simply due to the presence of a diver carrying a bright light.

Marginellids are sometimes able to hang on when the fish darts away. However, these parasites are small enough that their feeding probably has little effect on a healthy adult scarid.

Approximately 5-10% of the adult scarids on the Kwajalein reef form mucus bags; for juvenile scarids, the percentage is higher. When present, these bags do not protect the fish from parasitism by *Colubraria*; the mucus is easily penetrated by the snail itself or by its long proboscis. On several occasions, a small *C. tortuosa* or *C. nitidula* was observed to crawl up the side of a mucus bag surrounding a scarid and extend its proboscis through the bag to the fish.

The mucus bags might offer some protection against marginellid parasites; although often seen crawling on the bag, marginellids rarely are on the protected fish inside.

Acknowledgment

Thanks to Regina Kawamoto for her assistance in the hunt for the elusive *Colubraria* radula.

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Table 1. Associations of Kwajalein Atoll colubrariids at night.

	On Fish	Not On Fish
C. castanea	3	1
C. clathratus	0	>100
C. muricata	5	8
C. nitidula	>100	9
C. obscura	4	0
C. aff. obscura	5	0
C. tortuosa	>100	13

Table 2. Gastropod parasites observed on selected night dives. The first number in each column is the number of scarids with that column's species of parasite. In parentheses are the numbers of parasitic individuals per fish. Total number of fish with parasites is not always the sum of the fish with different parasites because occasionally more than one species of gastropod parasitizes a single host.

	NUMBER OF SCARIDS					
Date of observation	without parasites	with *Colubraria nitidula*	with *Colubraria tortuosa*	with *Colubraria obscura*	with *Kogomea ovata*	Total with Parasites
01/27/90	17	0	0	0	1 (3)	1
02/24/90	16	0	3 (1/1/1)	1 (1)	7 (8/6/2/1/1/1/1)	11
02/24/90	33	3 (2/2/1)	4 (3/1/1/1)	0	7 (14/9/8/8/4/3/2)	12
03/02/90	9	0	0	0	3 (2/1/1)	3
03/10/90	8	0	0	0	3 (4/3/1)	3
03/16/90	6	0	1 (1)	0	1 (18)	2
03/23/90	16	0	3 (1/1/1)	0	4 (1,1,1,1)	6
03/30/90	9	0	1 (1)	0	2 (1/1)	2
03/31/90	11	0	2 (2)	0	2 (1/1)	4
04/13/90	10	0	0	0	2 (2/1)	2
04/14/90	15	1 (3)	2 (1/1)	0	2 (10/2)	5
04/21/90	14	1 (1)	2 (1/1)	0	3 (9/4/4)	5
10/25/91	22	0	2 (3/1)	0	1 (4)	3
12/27/91	18	0	1 (1)	0	4 (8/3/2/2)	5
01/04/92	24	1 (2)	3 (2/2/2)	0	2 (4/3)	5

Editor's note: An excellent color photograph by Doug Perrine of a colubrariid parasitizing a sleeping scarid appeared in the October 1995 issue of **Sport Diver** magazine.

LATIRUS BELCHERI (REEVE, 1847): A NEW ADDITION TO THE TROPICAL EASTERN PACIFIC FAUNA

DONALD R. SHASKY

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"Clipperton '94: An Initial Report" by Michael Small did not mention other collecting sites on the routes to and from Clipperton Island from San Diego, California. On the return trip, a stop was made at Isla Clarión, Islas Revillagigedo, Mexico.

Collecting was done by SCUBA in 10 to 15 meters under rocks and in coral rubble. Captain James Black, one of the divemasters for the expedition, collected several species of shells which he sent to me. Included were a number of specimens of *Latirus socorroensis* Hertlein & Strong, 1951.

The most exciting shell in this collection is a 22.9 mm specimen of *Latirus belcheri* (Reeve, 1847) (Figures 1 & 2). A recent immigrant into Mexico?

I want to thank Jim Black for his gift of the shells, Dave Mulliner for his excellent photographs, and Henry Chaney for the collecting data.

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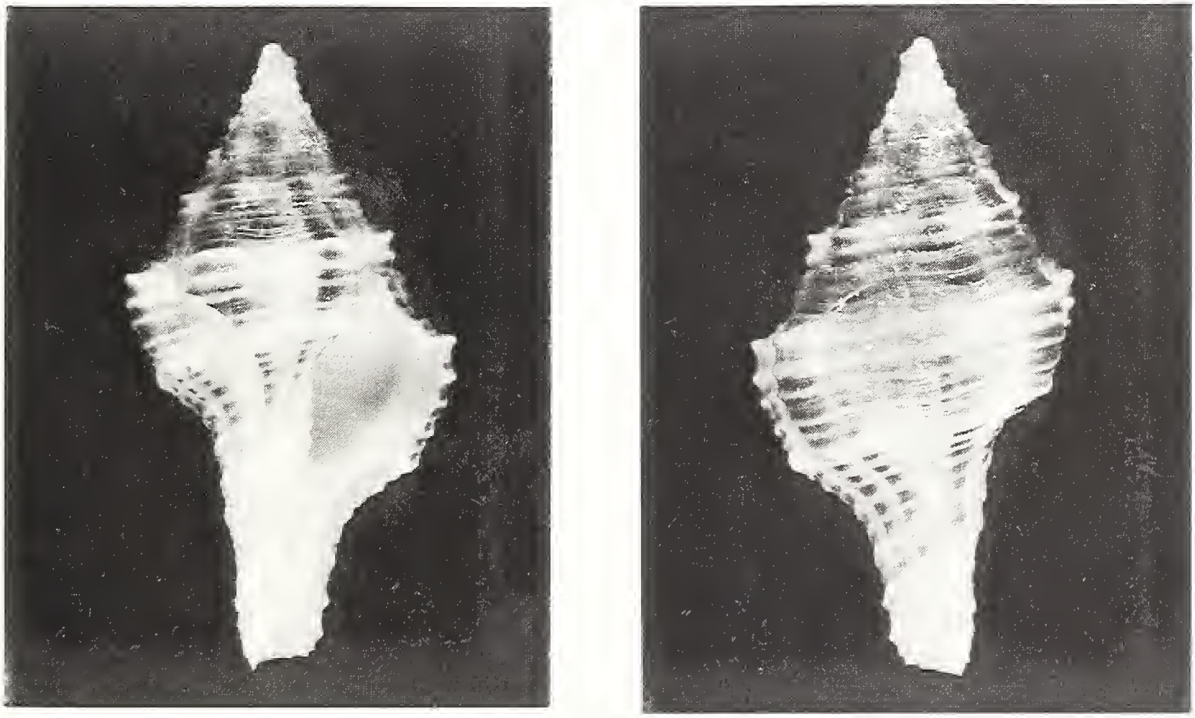

Figures 1 & 2. *Latirus belcheri*, 22.9 mm L, Isla Clarión, Islas Revillagigedo, Mexico. Leg. Jim Black, May 1, 1994. Shasky Collection. (1) apertural view (2) dorsal view. Photos: D.K. Mulliner.

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THE FESTIVUS
A publication of the San Diego Shell Club

COMPREHENSIVE INDEX TO THE FESTIVUS
1970-1995

Compiled by

Carole M. Hertz & Jules Hertz

Vol. I, No. 1 through Vol. XXVII, No. 11
Publication date: March 14, 1996

This index is a compilation of the articles and papers which have appeared in **The Festivus** since its inception in 1970. It is arranged both by author and by key words. The author index is arranged alphabetically by author's last name; each entry including (in chronological order) year, title, volume, issue, pages and number of figures. The key word index is arranged alphabetically; each key word followed by entries in alphabetical order by author's last name, volume and issue. Under classes Gastropoda, Bivalvia and Cephalopoda, the data are listed alphabetically by family. The subclass Opisthobranchia is treated as one entity, separate from the Gastropoda, since many of the entries are checklists containing large numbers of nudibranch species from a vast variety of families. The Polyplacophora is also treated as one category since there are few papers and most are general in nature.

Our appreciation is extended to Paul H. Scott of the Santa Barbara Museum of Natural History who helped us get started on the database software for this index and gave many constructive suggestions.

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